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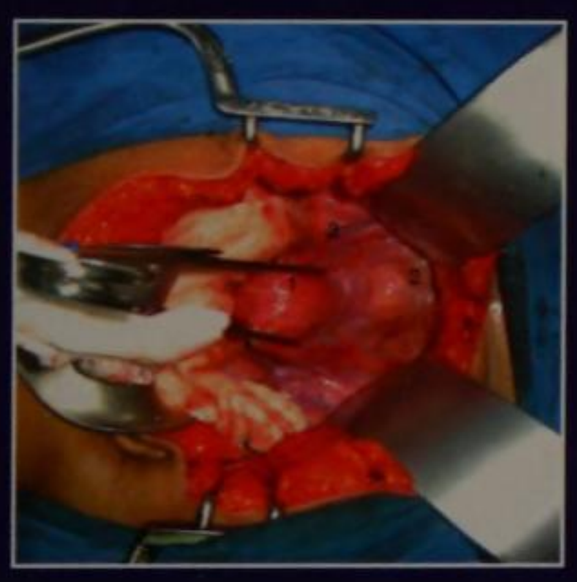
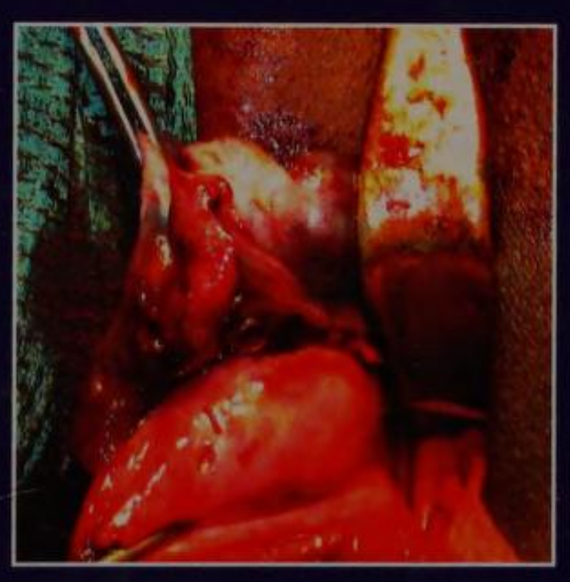
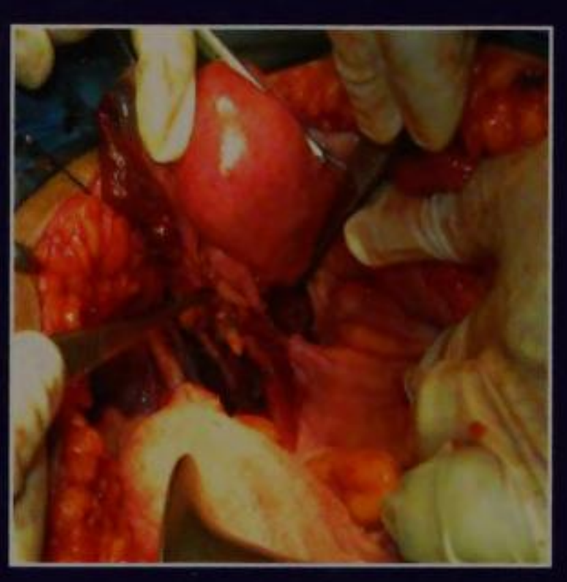
State-of-the-Art Vaginal Surgery



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Neerja Goel
Shalini Rajaram

Foreword
Neelam B Vaid

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State-of-the-Art
Vaginal Surgery

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    JB Sharma

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Dedicated to our respective husbands for the 'Knowledge Banks' and 'Critics' that they are
and
To our children who we hope will cultivate the fine art of writing

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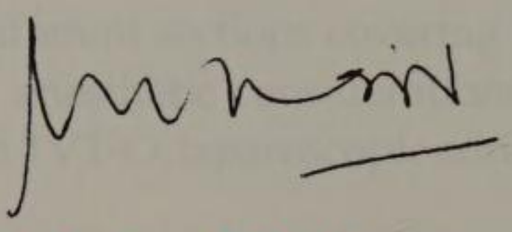
Foreword

I feel honored to write the 'Foreword' for this excellent book which my colleagues Prof Neerja Goel and Prof Shalini Rajaram have brought out yet again in one year. I must compliment them on this book, 'State-of-the-Art Vaginal Surgery' which covers various surgical procedures for congenital or acquired diseases, an art, which every gynecologist should master.

The young gynecologists would definitely be benefited in their future by the described surgical procedural details which are supported by perfect color illustrations and video records in this book.

I really appreciate the efforts of Editors to stimulate the youngsters from the department and colleagues from outside for getting their contributions. I wish they continue their spirit in future and besides being useful to specialty at large, bring laurels to the department and institution as well.

I wish the authors and this book all success.



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Preface

Surgery remains an art backed by scientific reason and thought. Although enormous advances have occurred in the medical management of a number of conditions, surgical therapy continues to be vital. Most gynecological conditions can be dealt through the vaginal route particularly disorders of pelvic floor, pelvic organ prolapse, benign vulval, vaginal, uterine and urological conditions. Ablative and excision therapy for intraepithelial neoplasia along with radical surgeries for genital malignancies are also approached vaginally.

Vaginal surgery in particular is a skill to be learnt and mastered. The need to teach surgery is a high priority but with increasing number of resident doctors and high obstetric load taking much of the time, teaching vaginal surgery is becoming increasingly difficult. In addition all surgical procedures cannot be practically demonstrated in a short span of a resident's career. Vaginal surgery results in a faster recovery with less hospital stay, is more economical and above all scarless; so it needs to be promoted.

With this aim I and Dr Shalini Rajaram have put together 50 chapters in 9 different sections covering almost all aspects of vaginal surgery, ranging from surgical anatomy, preoperative care, anesthetic considerations, surgical techniques keeping with the advances like video demonstrations of LEEP, TVT and TVT-O, laparoscopic adnexectomy, etc in addition to ample illustrations using color photographs and sketches.

We hope that this endeavor will reach out to postgraduate students and practicing gynecologists globally.

Neerja Goel
Shalini Rajaram

Acknowledgements

We take this opportunity to thank all the authors for their valuable time and thought that went into writing excellent chapters with good quality photographs, illustrations and surgical videos. We are truly indebted indeed.

A special thanks to Dr. Shirish Sheth and Dr. Alka Kripalani for being the 'Early Birds'. They sent in their complete chapters before the deadline 10th May 2006! That's the stuff great people and minds are made of! Close to follow on heel was Dr. Kanwal Gujral who scouted around and went that extra mile to get good quality illustrations for her chapter.

The oncosurgeons Dr. Chitrathara K and Dr. Partha Basu need to be applauded for making a difference to this book with their experience and deep insights into oncosurgical techniques and also Dr. JB Sharma for unconditional support in providing the TVT and TVT-O videos in addition to the VVF video. We thank Dr. Sankaranarayanan, Head, Screening Group WHO- International Agency for Research on Cancer (WHO-IARC), Lyon, France for allowing use of videos on Cryotherapy and LEEP from their Digital Learning Series and this would not have been possible without the thoughtful insight of Dr. Neerja Bhatla.

Dr. Neelam B Vaid, Head and the entire Faculty and Residents of the department of Obstetrics and Gynecology, UCMS and GTB Hospital need individual appreciation for supporting us with this enterprise. Dr. Sumita Mehta and Dr. Rachna Agarwal, new faculty of our department did an excellent job of proof-reading, again unconditionally, in addition to the brilliant chapters they contributed at short notice. Bouquets to both of them! Dr. Ashok K Saxena, who stood by us in our previous ventures again contributed significantly by both his expertise in anesthesia and in writing; we express our gratitude to him.

Words are not enough to thank Ms. Sunita Samvedi, Artist, for the outstanding and striking illustrations she has painstakingly sketched for most of the chapters. The nursing and technical staff of Gynecology operation theatre, GTB Hospital went out their way to assist us in any which way they could to make possible the video shoots and deserve special praise.

Finally JP Vij and his team need to be admired and congratulated for putting together this wonderful Book-cum-Atlas.

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Section I

Surgical Anatomy of Female Genital Tract

1 Vulva: Anatomy, Blood Supply and Lymphatic Drainage

Asha Sharma, Amita Suneja

The term pudendum or vulva includes the mons pubis, labia majora, labia minora, clitoris, vestibule, vestibular bulb and the greater vestibular glands (Figs 1.1 and 1.2).

MONS PUBIS

This name refers to the rounded eminence situated anterior to the pubic symphysis, formed by a mass of subcutaneous adipose connective tissue, covered by coarse hair at the time of puberty over an area usually limited above by an approximately horizontal boundary.

LABIA MAJORA

These two prominent, longitudinal, cutaneous folds extending back from the mons pubis to the perineum form the lateral boundaries of the pudendal cleft, into which the vagina and urethra open. Each labium has an external, pigmented surface, covered with crisp hair and a pink, smooth, internal surface with large sebaceous follicles. Between these surfaces is a large amount of loose

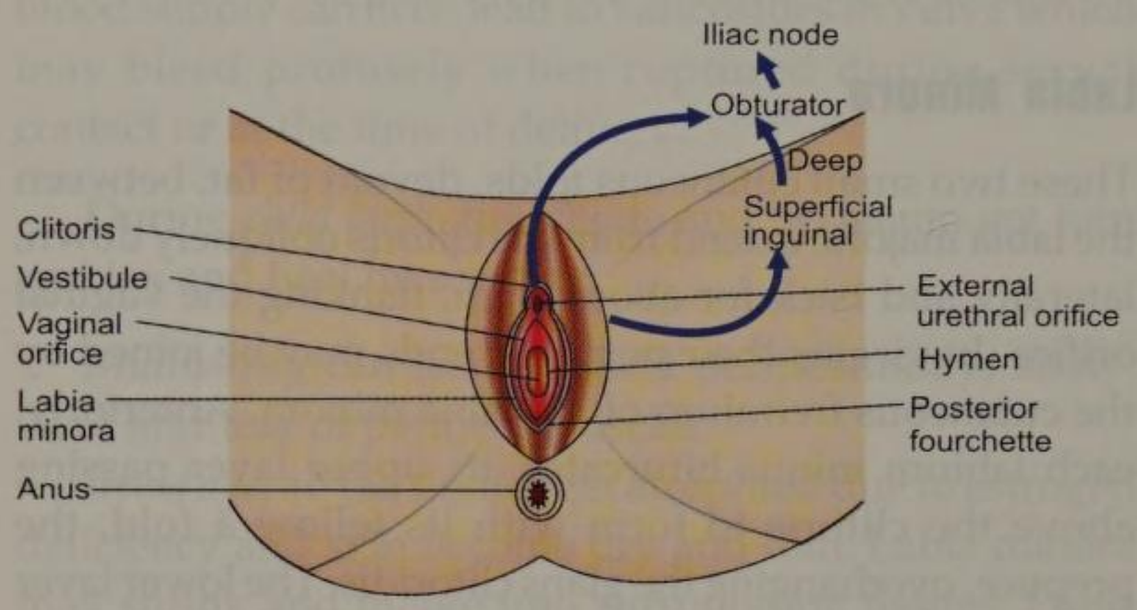

Fig. 1.1: Female external genitalia and its lymphatic drainage

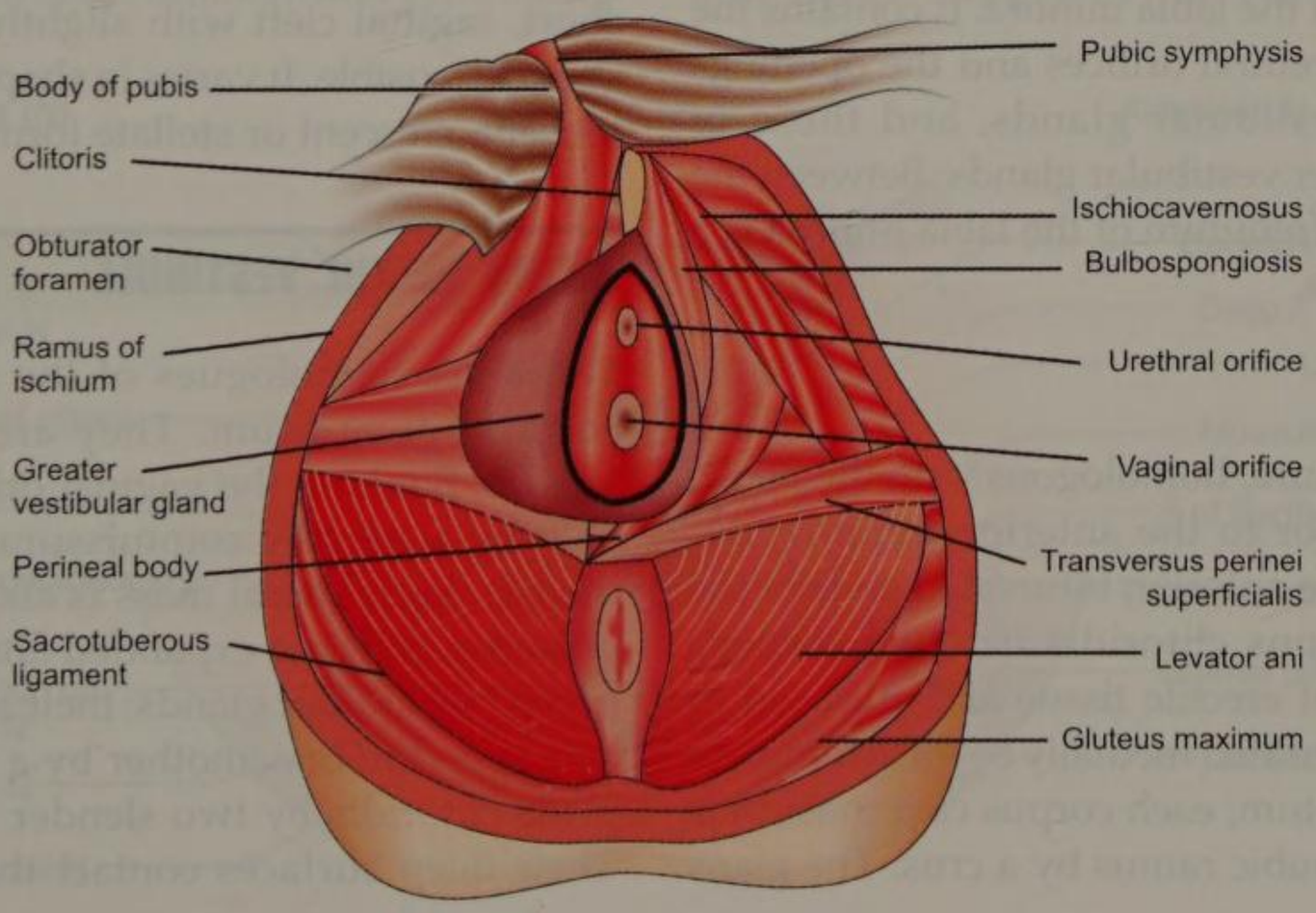

Fig. 1.2: The female perineum

connective and adipose tissue, intermixed with smooth muscle resembling the scrotal dartos muscle, together with vessels, nerves and glands. The uterine round ligament may end in the adipose tissue and skin in the anterior part of the labium. A persistent processus vaginalis and congenital inguinal hernia may also reach a labium. The labia are thicker in front, where they join to form the anterior commissure. Posteriorly they do not join but merge into neighbouring skin, ending near and almost parallel to each other; with the connecting skin between they form a low ridge, the posterior commissure, which overlies the perineal body; this is the posterior limit of the vulva; the interval between this and the anus, a distance of 2.5-3 cm, is the *'gynecological' perineum.*

Labia Minora

These two small cutaneous folds, devoid of fat, between the labia majora, extend from the clitoris obliquely down, laterally and back for about 4 cm, flanking the vaginal orifice. In virgins their posterior ends may be joined by the cutaneous frenulum of the labia minora. Anteriorly, each labium minus bifurcates, its upper layer passing above the clitoris to form with its fellow a fold, the prepuce, overhanging the glans clitoridis. The lower layer passes below the clitoris to form with its fellow the frenulum clitoridis. Sebaceous follicles are numerous on the apposed labial surfaces. Sometimes an extra labial fold (labium tertium) is found on one or both sides between the labia minora and majora.

Vestibule

This cavity lies between the labia minora. It contains the vaginal and external urethral orifices and the openings of the two greater vestibular glands, and those of numerous mucous lesser vestibular glands. Between the vaginal orifice and the frenulum of the labia minora is a shallow vestibular fossa.

Clitoris

This is an erectile structure, homologous with the penis, and lies postero-inferior to the anterior commissure, partially enclosed by the anterior, bifurcated ends of the labia minora. The corpus clitoridis has two corpora cavernosa, composed of erectile tissue and enclosed in dense fibrous tissue separated medially by an incomplete fibrous pectiniform septum; each corpus cavernosum is connected to its ischiopubic ramus by a crus. The glans clitoridis is a small round tubercle of spongy erectile tissue; its epithelium has high cutaneous sensitivity, important in sexual responses. The clitoris, like the penis, has a 'suspensory' ligament and two small muscles, the ischiocavernosi attached to its crura. In many details it is a small version of the penis, but differs from it basically in being separate from the urethra.

VAGINAL ORIFICE (INTROITUS)

This is usually a sagittal slit positioned postero-inferior to the urethral meatus; its size varies inversely with that of the hymen; like the vagina it is capable of great distension during parturition and to a lesser degree during coitus.

Hymen Vaginae

This is a thin fold of mucous membrane situated just within the vaginal orifice; the internal surfaces of the fold are normally folded to contact each other and the vaginal orifice appears as a cleft between them. The hymen varies greatly in shape and area; when stretched, it is annular and widest posteriorly; sometimes it is semilunar, concave towards the pubes; occasionally it is cribriform or fringed. It may be absent or form a complete, imperforate hymen. When it is ruptured, small round carunculae hymenales are its remnants. It has no established function.

External Urethral Orifice

This opens about 2.5 cm postero-inferior to the glans clitoridis, anterior to the vaginal orifice: it is usually a short, sagittal cleft with slightly raised margins and is very distensible. It varies in shape from a round aperture to a slit, crescent or stellate form.

BULBS OF THE VESTIBULE

These are homologues of the single penile bulb and corpus spongiosum. They are two elongate erectile masses, flanking the vaginal orifice and united in front of it by a narrow commissura bulborum (pars intermedia). Each lateral mass is about 3 cm in length; their posterior ends are expanded and are in contact with the greater vestibular glands; their anterior ends are tapered and joined to one another by a commissure, and to the glans clitoridis by two slender bands of erectile tissue. Their deep surfaces contact the inferior aspect of the

urogenital diaphragm. Superficially each is covered by a muscle, the bulbospongiosus. Thus, the female corpus spongiosum is cleft into bilateral masses, except in its most anterior region, by the vestibule and the vaginal and urethral orifices.

GREATER VESTIBULAR GLANDS (GLANDS OF BARTHOLIN)

These are homologues of the male bulbo-urethral glands; they consist of two small, round or oval reddish-yellow bodies, flanking the vaginal orifice, in contact with and often overlapped by the posterior end of the vestibular bulb. Each opens into the vestibule, by a duct of about 2 cm, in the groove between the hymen and labium minus. They are not infrequent sources of vulval neoplasm. In microstructure, the glands are composed of tubulo-acinar tissue, its secretary cells columnar in shape, secreting clear or whitish mucus with lubricant properties, stimulated by sexual arousal. In addition, recent studies have shown the presence of endocrine cells in these and the minor glands of the vestibule, using immunohistochemical methods; their contents include serotonin, calcitonin, bombesin, hCG and katacalcin.[1]

CHANGES IN VULVA WITH AGE AND PARITY

The tissues of vulva are sensitive to sex hormones mainly estrogen, so with age, changes do occur in vulva.

In *newborn* babies, labia majora are plump due to maternal hormones. As the effects of maternal hormones wean off, labia majora become thinner and labia minora and clitoris become relatively prominent and protruding.

In *Adolescent stage*, female hormones start increasing causing an increase in labial fat making labia minora and vaginal orifice get hidden between two labia majoras. Pubic hair starts developing on mons pubis and later on labia majora. Labia minora is devoid of hair follicles. With sexual activity hymen gets torn.

During pregnancy, vulva and vagina become hyperemic and engorged due to increased blood flow. This can greatly increase sexual sensitivity and pleasure. The increased amount of discharge can even cause considerable wetness and can also promote growth of pathological organisms. Candidal vulvitis is a common condition encountered during pregnancy. Increased blood supply can even lead to varicosities in vulva which may bleed profusely when ruptured during sexual contact or at the time of delivery.

During *child birth*, fourchette and perineum get torn and lax and heal by scarring.

Multiparity can lead to short perineal body, laxity, wear and tear of perineal muscles.

In *old age*, all the tissues get atrophied due to estrogen deficiency and skin become dry and thin. Labia minora may shrink and merge into surrounding tissues. Pubic hair becomes sparse. Perineal muscle tone decreases due to estrogen deficiency, making uterovaginal prolapse more evident in this age group.

Blood Supply (Fig. 1.3)

The arterial blood supply, venous and lymph drainage and nerve supply of the female external genitalia

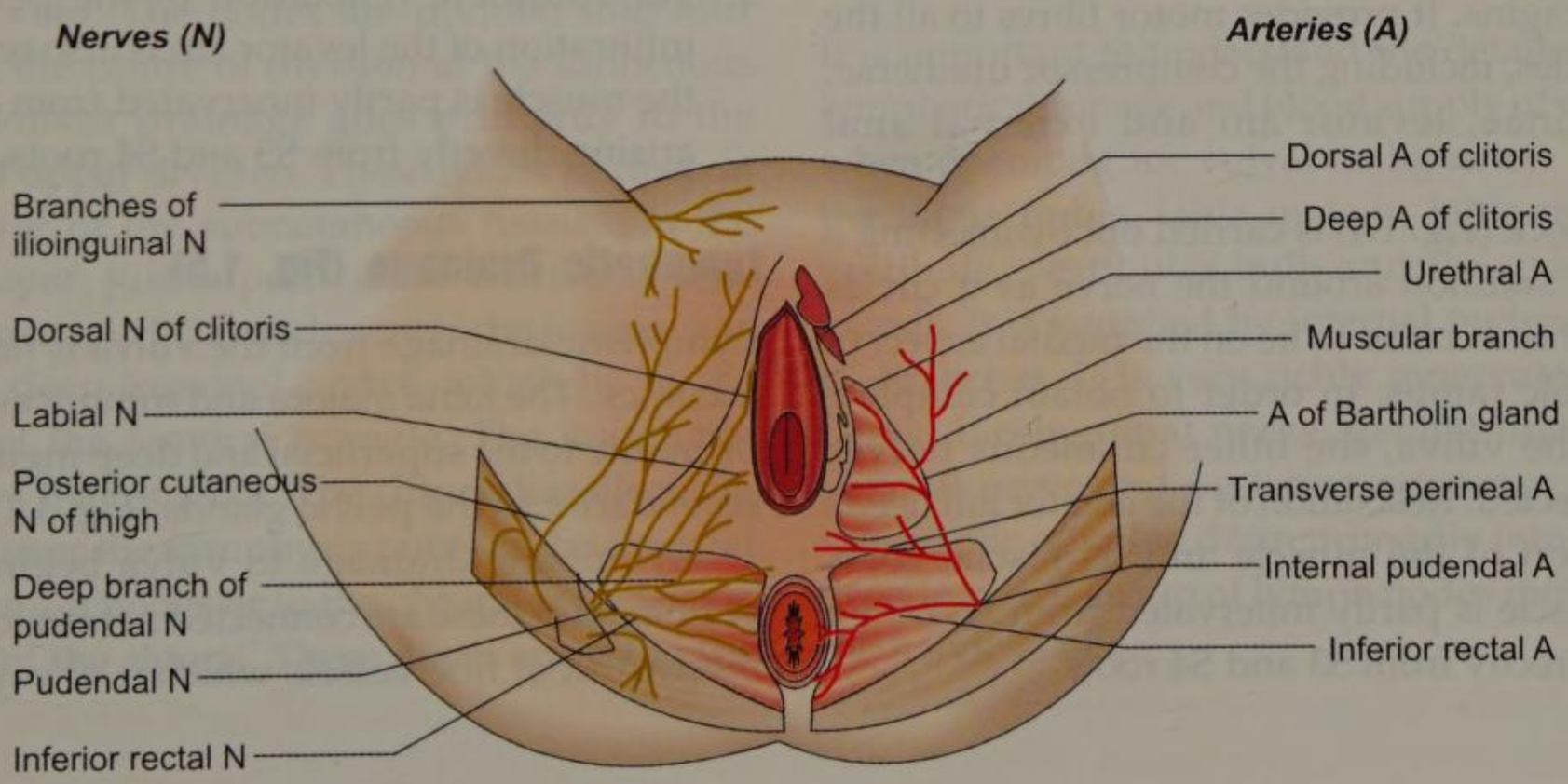

Fig. 1.3: Blood vessels and nerve supply of the vulva

resemble those of homologous structures in males. Vulva is supplied by internal pudendal artery and its branches. Internal pudendal artery is the terminal branch of the internal iliac artery which passes out of the pelvis through greater sciatic notch, curls around ischial spine and returns to the lateral wall of the ischiorectal fossa through lesser sciatic notch. It enters the layers of the triangular ligament to give branches to the labia, vagina, and bulbs of the vestibule, perineum and various muscles. It ends as the dorsal artery of the clitoris.

The veins of the vulva accompany the arteries and drain into internal pudendal vein, ultimately into internal iliac vein.

During vulvectomy, we have to keep in mind the surface anatomy of the nerves and vessels so as to avoid inadvertent damage and excessive blood loss. The main branches of the internal pudendal artery can be ligated beforehand.

Nerve Supply (Fig. 1.3)

The skin of the vulva is very sensitive and perineal injuries are especially painful.

Mons veneris and the foreparts of the vulva are supplied by the ilio-inguinal nerve and genital branch of genito femoral nerve both arising from L1 and L2 roots of the lumbar plexus. Clitoris is richly supplied by nerves and is highly sensitive. It gets erected during sexual excitation. The outer and posterior parts of the labia and the perineum receive some sensory fibres from the posterior cutaneous nerve of thigh.[2]

The pudendal nerve supplies sensory fibres to the skin of the vulva, external urethral meatus, clitoris, perineum and the lower vagina. It provides motor fibres to all the voluntary muscles, including the compressor uretherae, sphincter vaginae, levator ani and external anal sphincter.

Pudendal block (Fig. 1.4) is carried out by injecting a local anesthetic solution around the nerve as it circles the ischial spine and comes to lie on the medial aspect of the inferior pubic ramus. In order to obtain complete anesthesia of the vulva, the other cutaneous nerves require to be injected. Relaxation of the levator ani needs direct infiltration of the muscle and its fascial coats because the muscle is partly innervated from above by fibres arising directly from S3 and S4 roots.

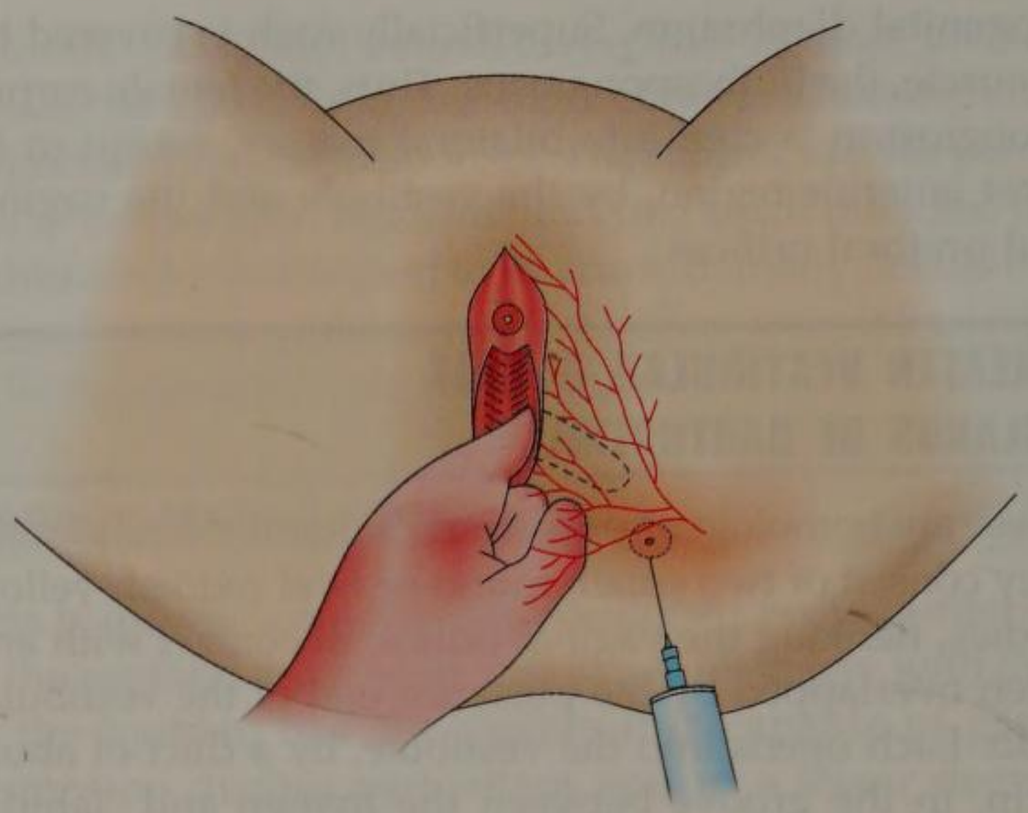

Fig. 1.4: Transperineal approach of pudendal block

CLINICAL APPLICATION

1. Pudendal nerve block is given to relax the perineal muscles so as to facilitate intravaginal manipulations during child birth or any other procedure. As already described, pudendal nerve curls around the ischial spine along with internal pudendal vessels and comes to lie on the medial aspect of the inferior pubic ramus. Therefore, to avoid injury to accompanying vessels, local anesthetic solution is injected around the nerve, 2 cm medial to ischial spine in sacrospinous ligament.
2. As vulva is supplied by different nerves, pudendal nerve block alone cannot cause complete anesthesia of the vulva. Thus, it is necessary to supplement it with local infiltration of the vulval skin before giving episiotomy.
3. For complete relaxation of the perineum, direct infiltration of the levator ani is also required because the muscle is partly innervated from above by fibres arising directly from S3 and S4 roots.

Lymphatic Drainage (Fig. 1.5)

Lymphatic drainage from the vulva is now known with accuracy. The labia majora and minora and clitoris drain primarily to the superficial and deep inguinal nodes then secondarily to the pelvic glands (Fig. 1.1).[3, 4]

Lymphatic drainage to vulva begins with minute papillae and these are connected in turn to a multilayered meshwork of fine vessels which is always limited to an

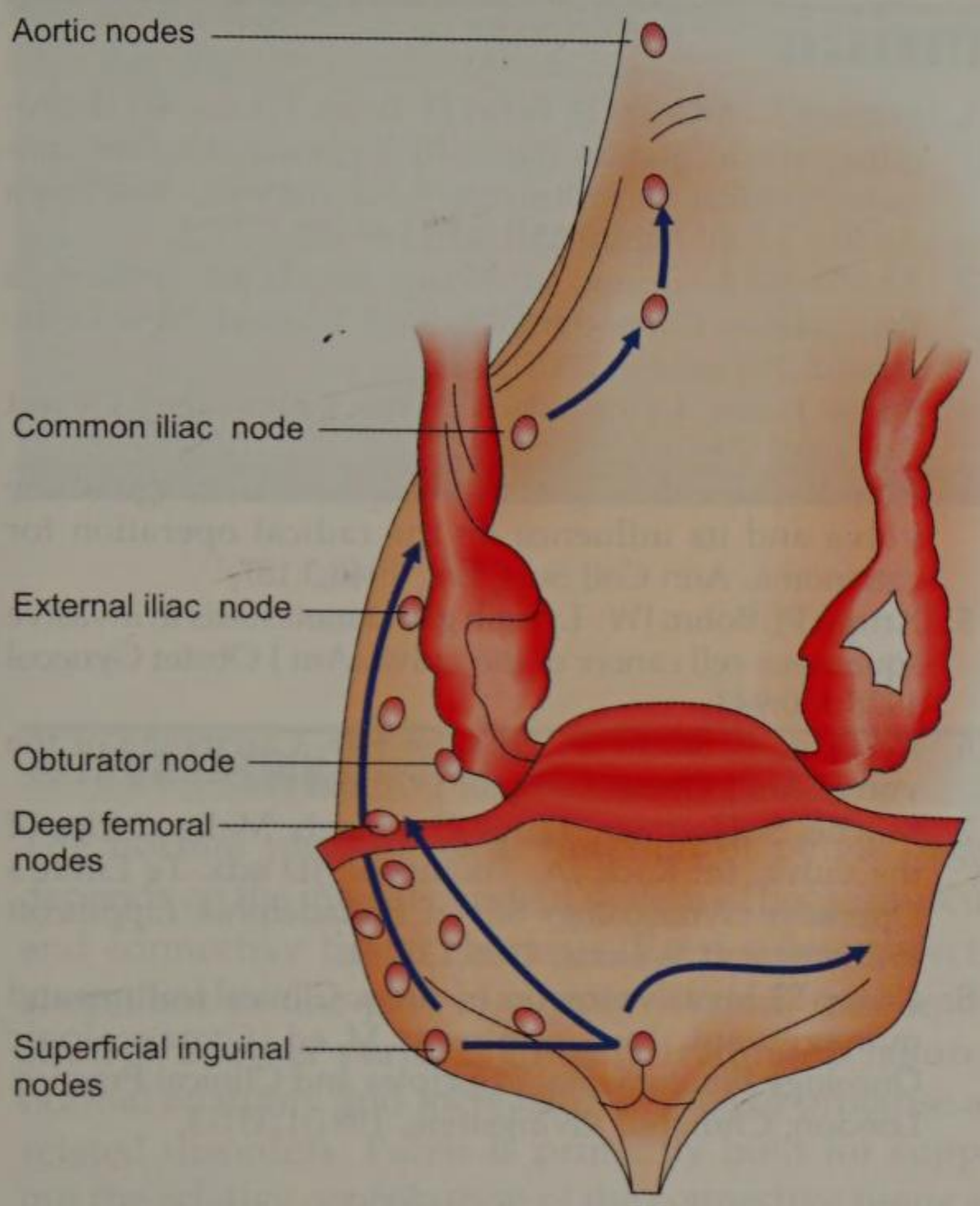

Fig. 1.5: Lymphatic drainage of carcinoma vulva (Note the possible contralateral spread of cancer especially from anterior vulva and clitoris)

area medial to genito crural fold. Labia majora and minora drain primarily to the superficial inguinal lymph nodes. There are 12-20 superficial inguinal lymph nodes and they lie in a T-shaped distribution 1 cm below the inguinal ligament, with the stem extending down along the saphenous vein. The nodes are divided into four quadrants with the centre of division at the saphenous opening. The vulvar drainage goes primarily to the medial nodes of upper division. These nodes lie deep in the adipose layer of the subcutaneous tissues, in the membranous layer, just superficial to the fascia lata. Lymphatics from superficial nodes enter the fossa ovalis and drain into deep inguinal nodes, which lie in the femoral canal of the femoral triangle. The fourchette drainage follows that of labia. The clitoris has alternate channels either over the symphysis pubis to the external iliac group of lymph nodes or to the obturator nodes via the dorsal vein of the clitoris. These direct entries to the pelvic system may account for the higher incidence of pelvic gland metastasis with clitoral lesions over those of labial lesions (Fig. 1.5).[5,6]

Confluence of this lymphatic network renders contralateral metastasis not unusual and even frequent in incidence.

Most authors agree that superficial inguinal glands can serve as the sentinel nodes of the vulva. The deep femoral nodes are the secondary node recipients and are involved before drainage into deep pelvic nodes occurs. Lymphatic drainage of the vulva is a progressive systemic mechanism and therapy can be planned according to where in the lymphatic chain tumor can be present.[7, 8]

Although lymphatic drainage from the clitoris directly into the deep pelvic nodes is described, their clinical significance seems to be minimal. It is unusual to find a case with metastasis to pelvic lymph nodes without metastasis to inguinal nodes, even when clitoris is involved.

The knowledge of the lymphatic drainage of the vulva is very crucial as spread of squamous cell cancer of the vulva is mainly by lymphatic route. Lymph glands are usually involved in succession as described above. It helps in staging the vulval malignancy and deciding its management.

During surgical management of carcinoma vulva, lymphatic drainage of the involved vulva is kept in mind. If the inguinal lymph nodes are not involved, pelvic lymphadenectomy is not generally required.

CONCLUSIONS

It is important to understand the detailed anatomy and lymphatic drainage and blood supply of vulva especially when operating for vulval malignancy. Vulva includes the mons pubis, labia majora, labia minora, clitoris, vestibule, vestibular bulb and the greater vestibular glands. It is supplied by internal pudendal vessels and its branches. It is very richly innervated by pudendal nerve, ilio-inguinal nerve, genital branch of genitor-femoral nerve and posterior cutaneous nerve of thigh. Lymphatic of vulva drain primarily into superficial and deep inguinal group of lymph nodes then secondarily to the pelvic glands.

Key Points

1. Vulva includes the mons pubis, labia majora, labia minora, clitoris, vestibule, vestibular bulb and the greater vestiblar glands.
2. Various changes occur with age, parity and during pregnancy in vulva.
3. Vulva is supplied by internal pudendal vessels and its branches.
4. It is very richly innervated by pudendal nerve, ilio-inguinal nerve, genital branch of genitor-femoral nerve and posterior cutaneous nerve of thigh.
5. Lymphatic of vulva drain primarily into superficial and deep inguinal group of lymph nodes then secondarily to the pelvic glands.
6. The knowledge of the lymphatic drainage of the vulva is important as spread of squamous cell cancer of the vulva is mainly by lymphatic route.

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2

Pelvic Diaphragm and Supports of Uterus

Abha Sharma

INTRODUCTION

The normal physiological function of pelvic organs depends on the interdependent system of bony, muscular and connective tissue elements. Even subtle defect or alterations in one part of support system may lead to stresses in other parts, eventually leading to failure of normal anatomy and increasing degree of prolapse and related disorders. Pelvis is primarily built for support but the relative contribution of the connective tissue and levator muscles has been a subject of debate for long. Current view is that; *muscles of pelvic diaphragm provide the primary dynamic support to the pelvic viscera aided by ligaments/connective tissue which keep the viscera in position.*[1] An understanding of normal, applied anatomy is therefore essential for a pelvic surgeon.

The Bony Pelvis

The pelvic organs, pelvic floor muscles and connective tissue of pelvis attached to and are ultimately supported by the bony pelvis. It comprises of two hip bones, the sacrum and the coccyx. The hip bone consists of the ilium, ischium and pubis which fuse at the acetabulum. The ilium articulates with the sacrum posteriorly at the sacroiliac joints and the pubic bone articulates with each other anteriorly at the symphysis pubis.

The pelvic cavity is a curved canal with a shorter anterior wall made of pubic bones and longer posterior wall made of sacrum. Due to lordosis of lumbosacral spine, the pelvic inlet makes an angle of 60° from the horizontal with posterior aspect being higher. *This more vertical orientation of pelvic inlet deflects downward forces onto the superior symphsis pubis rather than the pelvic outlet and urogenital hiatus.*[2] Therefore, the pelvic outlet is shielded from downward stresses in the anatomically normal woman.

Muscles of the Pelvic Diaphragm

The muscles that span the pelvic floor are collectively known as pelvic diaphragm and are the primary support of pelvis. It consists of levator ani and coccygeus muscles along with their superior and inferior investing fasciae. Inferior to pelvic diaphragm, the perineal membrane and perineal body also contribute to pelvic floor.

Levator Ani Muscles

These muscles form a basin or covering of the pelvic outlet and are crucial for pelvic organ support. The normal levators maintain a constant baseline tone. The muscle contains large quantities of type-I (slow twitch) fibres which remain tonically contracted and thus keep the urogenital hiatus narrowed and allow the pelvic viscera to rest on a muscular shelf.[3] The type-II (fast twitch) fibres allow the reflex muscle contraction elicited by sudden increases in intra-abdominal pressures. Thus the constant adjustment in muscle activity maintains pelvic floor closure in response to changing intra-abdominal pressure, in turn keeping the pelvic ligaments from stretching. Relaxation of levators occurs only briefly and intermittently during processes of voiding, defecation and parturition.

The Levator ani muscle is a complex unit comprising of pubococcygeus, puborectalis and iliococcygeus muscles. The pubococcygeus is further divided into pubovaginalis, puboanalis and puboperinealis muscles according to fibre attachments (Fig. 2.1). Because of its significant attachment to pelvic viscera, pubococcygeus is also described as pubovisceral muscle.[4]

Pubococcygeus

The anterior ends of pubococcygeus arise on either side from the inner surface of the pubic bone. The medial most

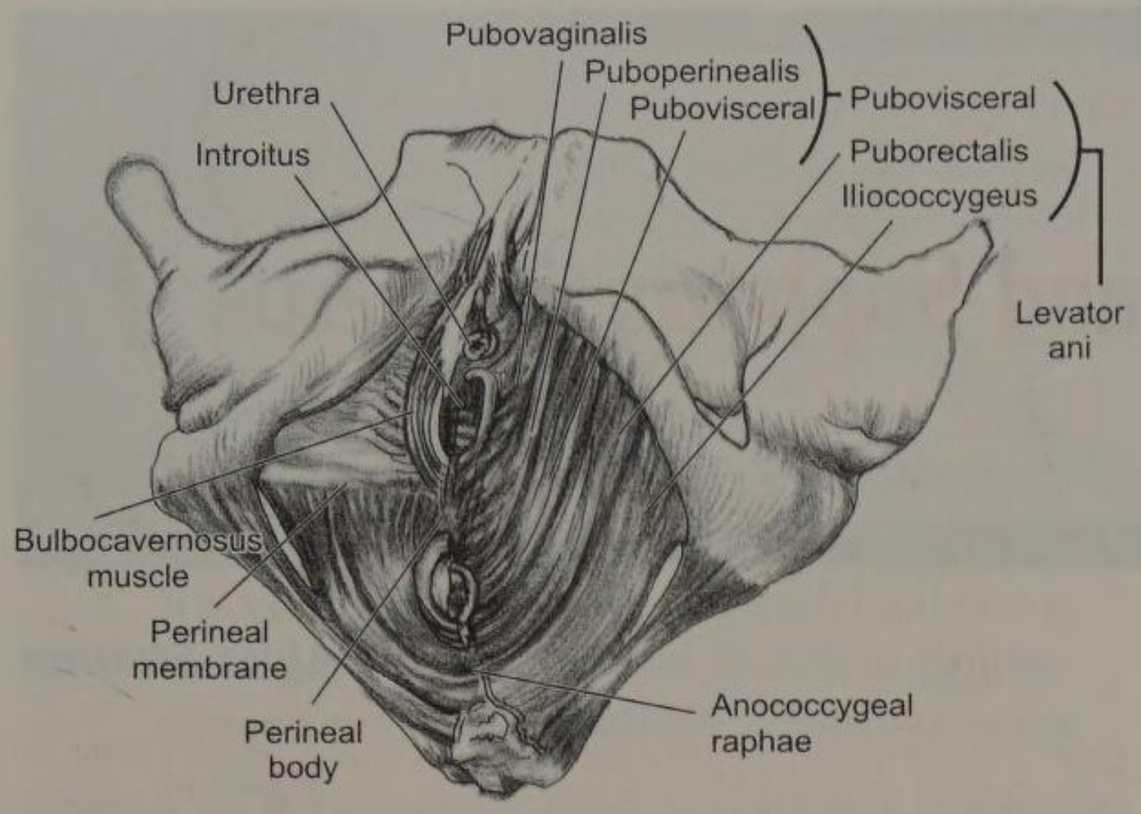


Fig. 2.1: Levator ani-arrangement of constituent muscles. Superficial perineal muscles have been removed from left side to show attachment of LA to pelvic viscera. Perineal membrane is visible on right side

fibres attach to lateral walls of vagina and are known as *pubovaginalis*. They also indirectly support the urethra by elevating vagina during pelvic muscle contraction and hence, are important for urinary continence.[5]

The *puboperinealis* refers to the fibres that attach to perineal body and draw it towards symphysis pubis.

The *puboanalis* refers to fibres that attach to the anus at the intersphincteric groove between the internal and external sphincter. These fibres elevate the anus and along with rest of pubococcygeus and puborectalis keep the urogenital hiatus narrowed (Figs 2.2A and B).

Puborectalis

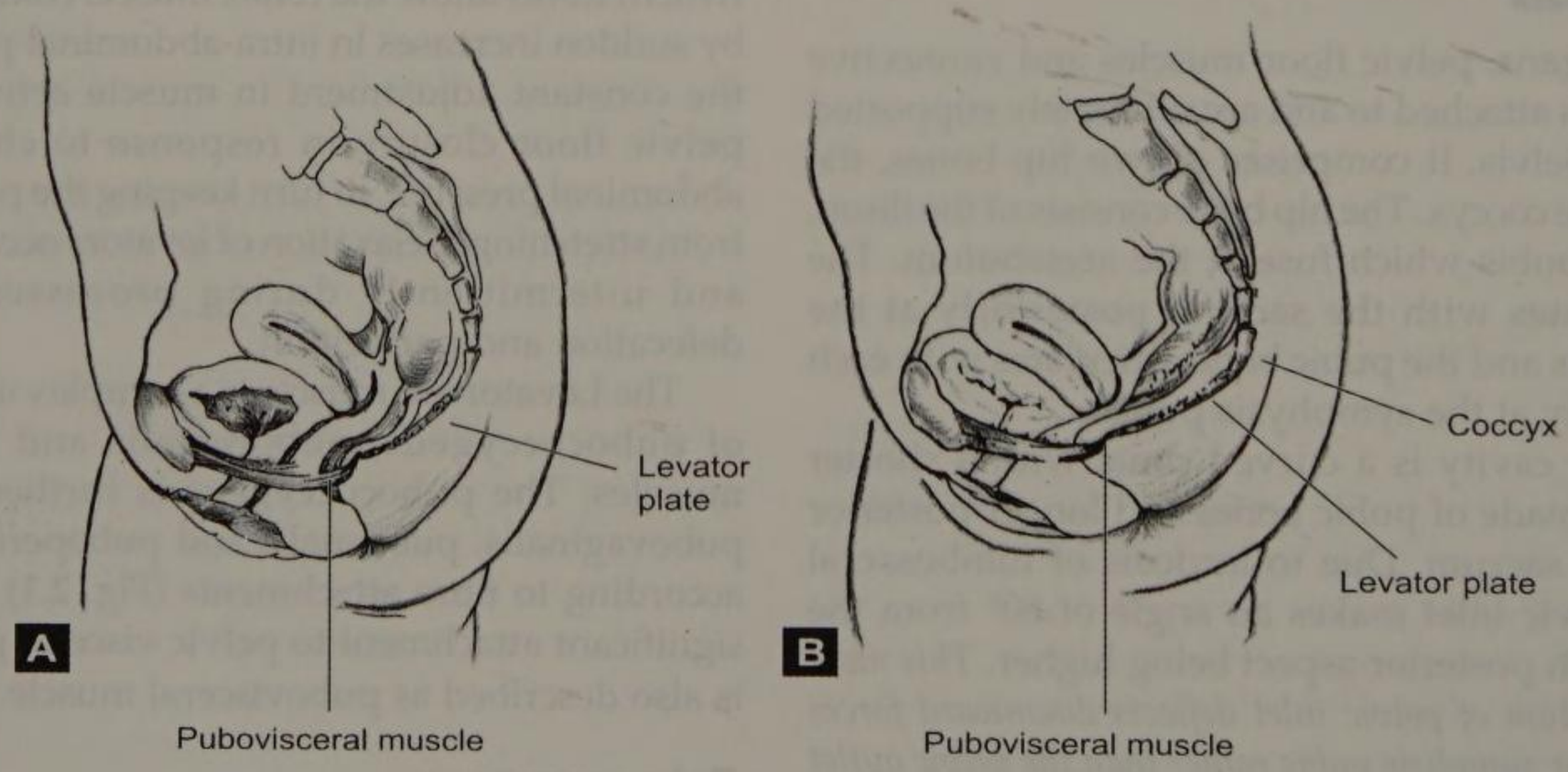
It arises from posterior aspect of pubic bone and forms a "U" shaped sling behind the anorectal junction. It pulls the anorectal junction towards the pubic symphysis.

Iliococcygeus

It is the most posterior and thinnest part of levators and has a supportive role. It arises laterally from Arcus tendineous levator ani (ATLA) and the ischial spines. Both sides join in the midline at anococcygeal raphae and the coccyx.

The Urogenital Hiatus

The U-shaped opening in levator ani muscles through which the urethra,vagina and rectum pass is known as urogenital hiatus (UGH). Its boundaries are ; anteriorly, the pubic bones; laterally, the pubococcygeus and puborectalis and posteriorly, the perineal body. The enlargement of UGH predisposes to prolapse.



Figs 2.2A and B: (A) Pubovisceral (PV) muscle at rest, (B) Reflex contraction of pubovisceral muscle constricts the urethra, vagina and rectum with increase in intra-abdominal pressure

Levator Plate

The levator plate refers to the connective tissue band between anus and coccyx formed by insertion of iliococcygeus muscles at anococcygeal raphae.In a normal woman it lies just parallal to the horizontal plane in standing position and upper vagina, uterus and rectum rest on it[6] (Fig. 2.3).

In a normal woman, vagina is a curved organ with a lower convex perineal portion and a distinct upper portion that has an axis between the third and fourth sacral vertebra corresponding to the origin of uterosacral ligaments. The angle between upper and lower vaginal axis measures approximately 130 degrees. In standing position the vagina lies almost in a horizontal plane over the levator plate. Weakness of pelvic floor muscles allows the levator plate to sag and descend permanently.This causes the UGH to open, which in turn changes the normal horizontal axis of proximal vagina to a vertical orientation and predisposes to prolapse.*The restoration of vaginal axis is important during reconstructive surgery for effective functional cure*[7] (Fig. 2.4).

Nerve Supply

Traditionally a dual innervation is described – Superior surface of LA being supplied by direct efferents from S2-S5 nerve roots and inferior surface being supplied by pudendal nerve branches. Recent literature suggests the pudendal nerve does not contribute to levator muscle innervation.[8] It innervates parts of striated urethral sphincter and external anal sphincter by way of separate branches.

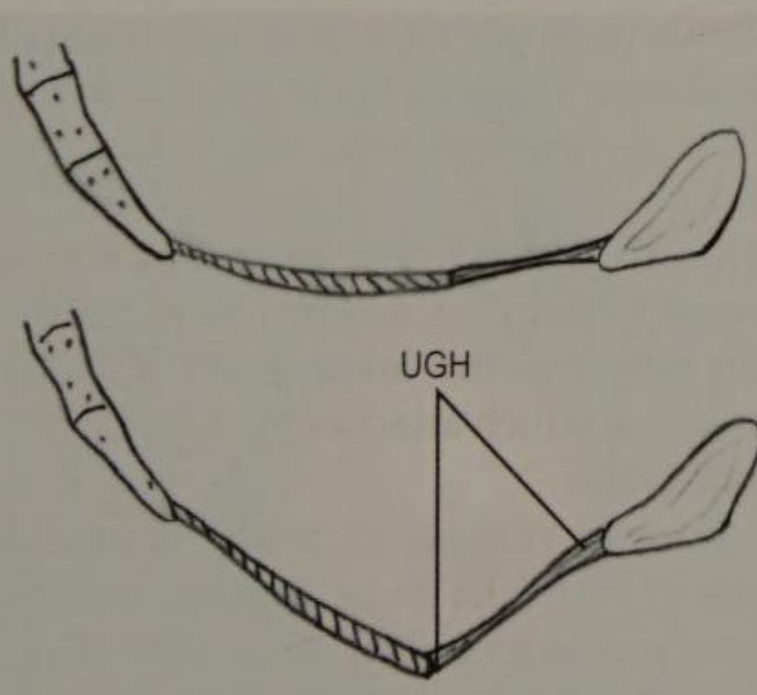
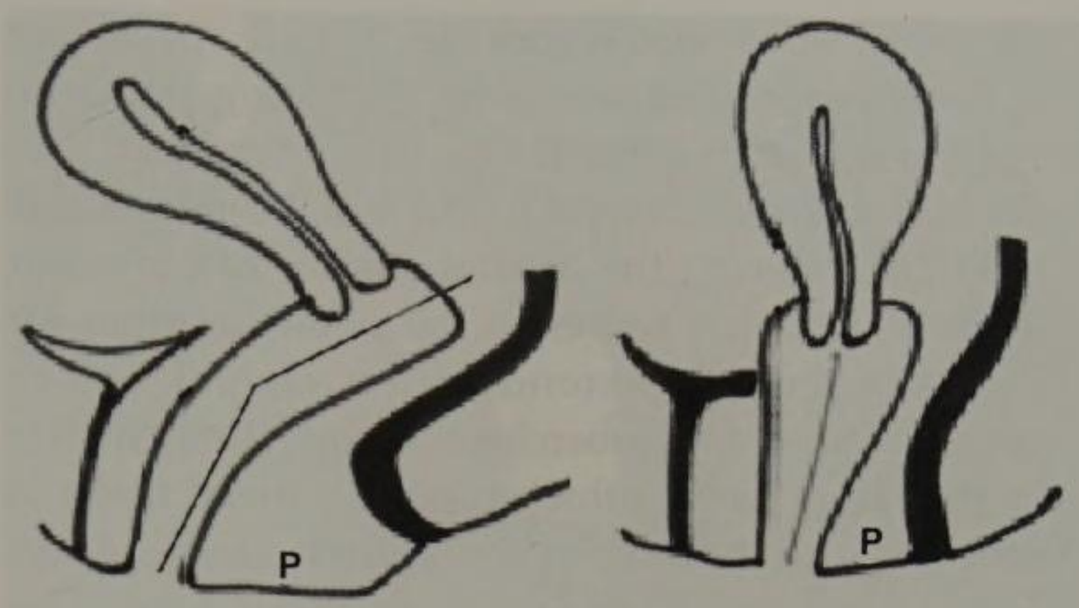


Fig. 2.3: Levator plate (L): As Levator muscle tone decreases, the levator plate sags opening the urogenital hiatus (UGH) predisposing the patient to development of prolapse



Figs 2.4A and B: Vaginal axis (A) Normal axis, (B) Loss of normal axis of vagina due to defective perineal body leading to vertical vagina

Perineal Membrane (Urogenital Diaphragm)

Perineal membrane is a sheet of dense fibromuscular tissue that spans the anterior pelvic outlet inferior to pelvic diaphragm. It attaches laterally to ischiopubic rami, medially to distal third of urethra and vagina, and posteriorly to perineal body. It provides support to distal vagina and urethra by attaching them to bony pelvis. The muscles that form the urogenital sphincter complex are present just above the perineal membrane (Fig. 2.1).

Perineal Body

The perineal body is a mass of connective tissue found between the distal third of posterior vaginal wall and anus. It is formed by the midline insertion of six structures; *Bulbocavernosus, Superficial transeverse perini, External anal sphincter muscles, perineal membrane, Levator ani muscles and distal part of rectovaginal septum.* The perineal body contributes to support the distal vagina and rectum.

Endopelvic Fascia and the Pelvic Ligaments

The connective tissues of pelvis are collectively known as the endopelvic fascia. The fibroelastic connective tissue matrix contains varying amount of smooth muscles. It is divided into three parts:[2]

1. Parietal fascia.
2. Visceral fascia.
3. Deep endopelvic connective tissue.

1. *Parietal fascia*: These fasciae are dense membranes investing the pelvic surface of the skeletal muscles of

the pelvic side walls. It provides muscle attachment to bony pelvis and serves as anchoring points to visceral connective tissue.

The *ATLA (arcus tendineus levator ani)*, a condensation of fascia covering the medial surface of obturator internus muscles, serves as the point of origin for iliococcygeus. It extends from ischial spines posteriorly, to pubic tubercles anteriorly. Immediately inferior to *ATLA* is a thickening of parietal fascia of iliococcygeal muscle belly, known as the *Arcus Tendineus Fascia Pelvis (ATFP)* or White Line. This structure is the lateral attachment point for the pubocervical fascia and proximal rectovaginal septum. It extends from the inner surface of pubic bones to the ischial spines (Fig. 2.5).

2. *Visceral fascia*: These are loose highly elastic and ill-defined encasement of central pelvic organs, sheathing them. They allow for the high degree of physiological distention necessitated by the function of pelvic organs. Vagina, uterus, bladder and rectum are invested by visceral fascia, whereas fallopian tubes and ovaries are not.
3. *Deep endopelvic connective tissue*: The deep endopelvic connective tissue condenses to form ligaments of pelvis. It also works as neurovascular conduit. The named structures of the deep endopelvic connective tissue include *six ligaments, two septae and one ring*. Their function is suspension of cervix in the posterior pelvis and consequent placement of vagina directly over the levator plate, away from direct exposure to the urogenital hiatus. The six pericervical ligaments form the *paracolpium*, namely (Fig. 2.5).
   A. *Pubocervical ligaments*: It arises from inferior surface of superior pubic ramus and white line and inserts at anterior and lateral supravaginal cervix. It is also known as Bladder Pillar.
   B. *Cardinal ligaments*: It arises from the hypogastric root and lateral pelvic walls, and inserts in lateral supravaginal cervix. The uterine artery and vein traverse in it. Also the ureter passes under the uterine artery in this.
   C. *Uterosacral ligaments*: It arises from the periosteum of S2-S4 vertebrae and inserts on posterolateral supravaginal cervix. These hold the cervix in posterior pelvis, maintaining anteversion of uterus.

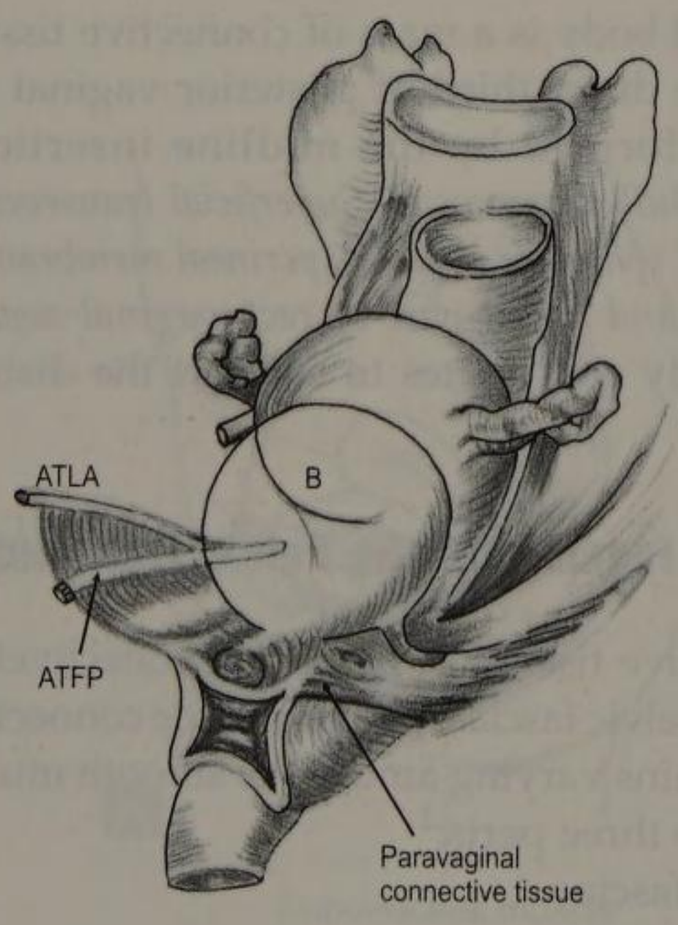


Fig. 2.5: Parietal fascia of pelvis showing ATLA and ATFP. Support of pelvic organs by endopelvic fascia and its attachment to ATFP is shown

Apart from ligaments, traditionally two septae are described within the deep endopelvic connective tissue viz., pubocervical septum and rectovaginal septum.

The existence of pubocervical septum has been disputed and histological examination of anterior vaginal wall has not shown any fascia between vagina and bladder. The vagina is separated from bladder by vaginal adventitia.[9] The tissue that attaches the lateral walls of vagina to ATFP, is a condensation of connective tissue which contains blood vessels, lymphatics and nerves. This paravaginal tissue attachment to lateral vaginal wall adventitia is responsible for the appearance of lateral vaginal sulci. This is the mainstay of midvaginal support.[10]

Rectovaginal septum or fascia of Denonvilliers is a connectinve tissue layer between vagina and rectum which extends from perineal body to 2-3 cm proximally only, it is absent superior to the level of rectovaginal pouch. It is connected laterally with paravaginal tissue.[11,12]

Based on these findings, the main support of the anterior and posterior vagina is provided by the interaction between the levator ani muscles and the connective tissue which attaches the lateral wall of vagina to the pelvic walls.

Although visceral connective tissue is continuous and interdependent, three levels of vaginal connective tissue supports have been described by DeLancey[13] (Fig. 2.6).

Cervical and Uppervaginal Support

Proximal vaginal level-1 support is attributed to ligaments of paracolpium mainly, cardinal and uterosacral

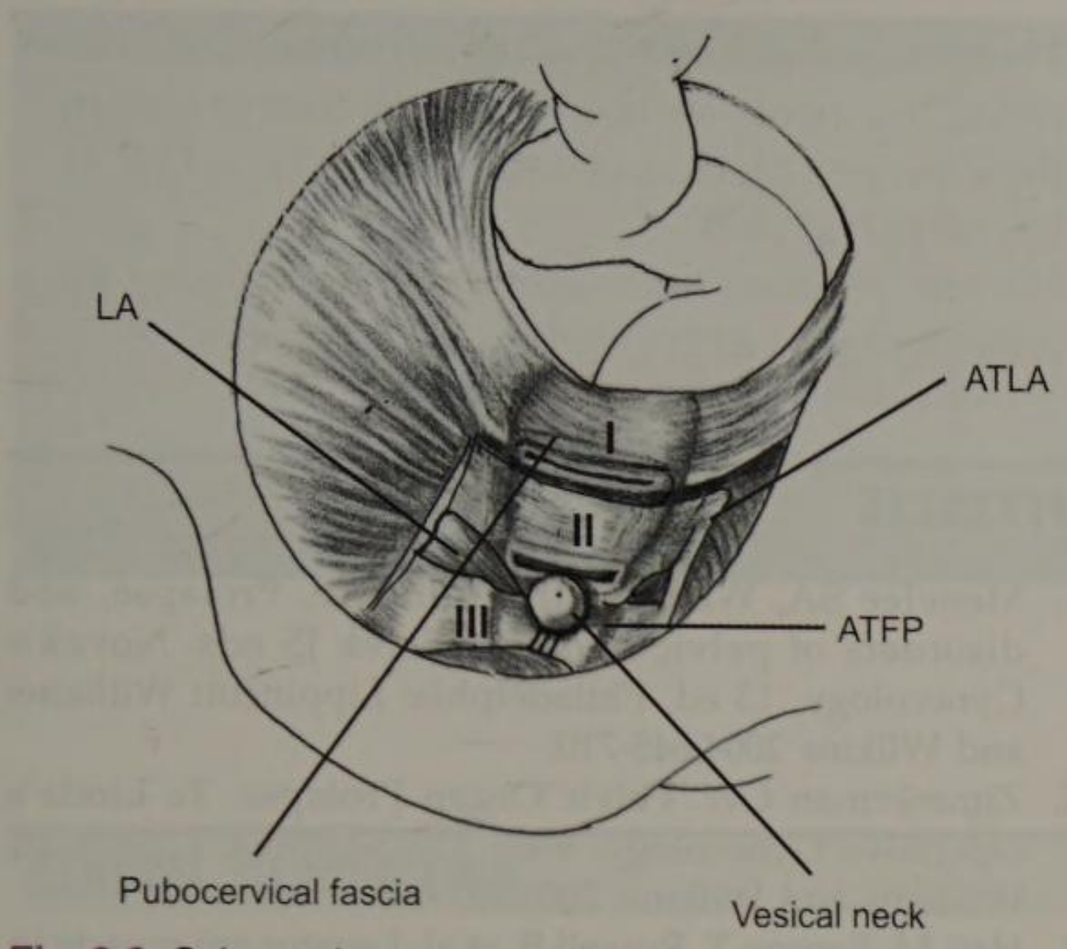


Fig. 2.6: Schematic representation of connective tissue defects as described by DeLancey: Level-1: Proximal suspension, Level-2: Lateral attachment, Level-3: Distal fusion

ligaments. Damage of level-1 support results in cervical prolapse, posthysterectomy vault prolapse and enterocele (Fig. 2.7).

Midvaginal Support

Midvaginal or level-2 support axis is due to lateral attachment of fascial septae to the pelvic sidewalls. The septae attach to ATFP and medial aspects of levator muscles. Attachment of anterior vaginal wall to the levators is responsible for the bladder neck elevation noted with cough. Clinical manifestation of level-2

Fig. 2.7: Apical (Level-1) support defect—Cervical prolapse

Figs 2.8A and B: Midvaginal (Level-2) support defect: (A) Cystocele; (B) Rectocele

support defects include: anterior and posterior vaginal wall prolapse and stress urinary incontinance (Fig. 2.8).

Distal Vaginal Support

The distal third of vagina directly attaches to its surrounding structures. Anteriorly the vagina is fused with urethra, laterally to pubovaginalis muscle and perineal membrane, and posteriorly to perineal body. These vaginal attachments are known as Level-3 support or *Fusion axis*, and they are considered strongest of vaginal support components. Damage results in urinary incontinence, distal rectoceles and perineal descent. Anal incontinence may also result if perineal body is deficient due to obstetrical trauma as in third degree perineal tears (Fig. 2.9).

Fig. 2.9: Level-3 Support defect: Deficient perineum and distal rectocele

CONCLUSIONS

To summarize, the etiology of pelvic floor prolapse is complex and multifactorial. It likely includes a combination of acquired dysfunction of pelvic floor muscles and/or of connective tissues, as well as genetic predisposition. However, the interaction between the pelvic floor muscles and connective tissue fascia is essential for the normal pelvic organ orientation and support. Significant contributions recently made to the area of pelvic floor support anatomy have led to a better understanding of pelvic organ dysfunction.

Key Points

1. Pelvic diaphragm provides a dynamic support to pelvic viscera.
2. Levator ani muscle fibres constantly adjust according to intra-abdominal pressure; keeping the pelvic viscera in position.
3. Loss of tone of levator muscles leads to sagging of levator plate and opening of urogenital hiatus thus predisposing to prolapse.
4. The endopelvic connective tissue condensations or pelvic ligaments anchor the uterus and vagina in their proper place and attach them to ATFP at lateral pelvic wall.
5. Normal perineal body and vaginal axis play an important part in prevention of prolapse.

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3 Uterus and Cervix: Relations, Blood Supply and Lymphatic Drainage

Neerja Goel, Ruchika Garg

GENERAL DESCRIPTION

The uterus is a thick-walled, muscular, hollow organ shaped like a pear, its tapering end being the cervix which projects into the upper vagina. It is situated in pelvis between the bladder in front and rectum behind. The measurements were formerly given as 3 × 2 × 1 inch but these understate its size. Its dimensions vary but the nulliparous organ measures approximately 8 cm (3¼ inch) in overall length 6 cm (2½ inch) from before backwards in its thickest part. It weighs 45-55 gm. The wall is 1-2 cm thick, so the length of the normal uterine cavity, including the cervical canal, is not less than 7 cm and may be 7.5-8.0 cm, it is covered on its anterior, superior and posterior surfaces by a medial continuation of the broad ligament peritoneum. This layer is also contiguous with that of bladder (vesicouterine pouch) and the pelvic side walls and rectum (rectouterine pouch).

The uterus is made up of a body or corpus, isthmus and cervix (Fig. 3.1). The part of the body situated above the level of insertion of the fallopian tubes is described separately as the fundus, especially during pregnancy. The area of insertion of each fallopian tube is termed the cornu. The opening of the cervix into the vagina is the external os uteri.

The cavity of the uterus is triangular in shape when seen from the front, but it is no more than a slit when seen from the side (Fig. 3.2). It communicates with the vagina through the cervical canal, and with the lumen of each fallopian tube at the cornua.

Fig. 3.1: Uterus and cervix

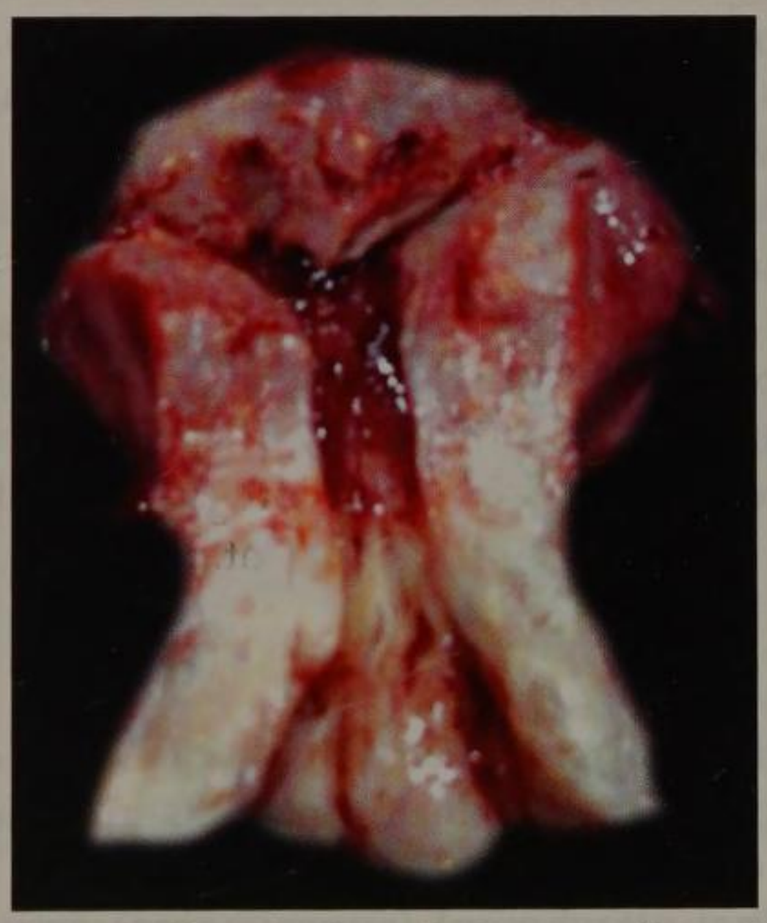

Fig. 3.2: Cut section of uterus and cervix

STRUCTURE

The whole of the fundus, the anterior wall as low as the isthmus, and the posterior wall as low as the attachment

of the vagina to the cervix are covered with peritoneum which is so intimately connected with the underlying muscle that it cannot be stripped away. The sides of the uterus between the attachment of the two leaves of the broad ligament, the lower anterior uterine wall, and the whole of the cervix except for the posterior aspect of its supravaginal part, are devoid of peritoneum. The main mass of the wall is composed of involuntary muscle fibres which for the most part run obliquely in a criss-cross spiral fashion. The more superficial fibres, however, are arranged longitudinally and are continuous with those forming the outer coats of the tubes and vagina. Fibrous and elastic tissues are mixed with the muscle in varying amounts. Internal to the muscle layers is a mucous membrane which is directly applied to the muscle without an intervening submucosa, so its glands often dip into the fibromuscular tissue.

Corpus (Including Fundus)

The corpus makes up two-thirds or three-quarters of the uterus of the mature woman. The main muscle coat (myometrium) is lined by endometrium – a specialized form of mucous membrane. The latter varies in thickness from 1 to 10 mm according to the phase of the menstrual cycle. It is covered by a single layer of cuboidal or columnar epithelium which dips in to form simple unbranched tubular or spiral glands, some of which are so long that they extend from the surface to the myometrium.

Isthmus

The isthmus is an annular zone, no more than 0.1-0.5 cm from top to bottom in the non-pregnant uterus, which lies between the cervix and the corpus. The obvious constriction between the uterine cavity and cervical canal is the anatomical internal os and the isthmus is below this. The junction between the isthmus and the cervical canal proper, which is only recognized microscopically, is the internal os. The importance of the isthmus is that it is the area which, during late pregnancy and labour, becomes the lower uterine segment.

Cervix

The cervix is barrel-shaped, measuring 2.5-3.5 cm from above downwards. Half of it projects into the vagina (vaginal cervix or portio vaginalis) while half is above the vaginal attachment (supravaginal cervix). The vaginal part is covered with squamous epithelium continuous with that of the vagina. The supravaginal part is surrounded by pelvic fascia except on its posterior aspect where it is covered with the peritoneum of the pouch of Douglas. The upper part of the cervix is composed mainly of involuntary muscle, many of the fibres being continuous with those in the corpus. The lower half has a thin peripheral layer of muscle (the external cervical muscle) but is otherwise entirely composed of fibrous and collagenous tissues.

The mucous membrane lining the canal (endocervix) is thrown into folds which consists of anterior and posterior columns from which radiate circumferential folds to give the appearance of tree trunk and branches, hence the name 'arbor vitae'. This arrangement is most obvious in the young nullipara in whom the irregularity of surface can make the passage of a sound difficult. Histologically, the endocervix differs considerably from the endometrium. It is covered by a single layer of tall columnar epithelial cells which, on the top of the folds but not in the crypts and glands, are ciliated. Beneath this is a layer of more cubical 'basal' or 'reserve' cells from which new surface cells are believed to develop and undergo squamous metaplasia.

The acini secrete an alkaline (pH 7.8) mucus, a gel rich in mucoproteins, mucopolysaccharides and fructose, the last having a nutritive function for spermatozoa. The physical and chemical properties of cervical mucus vary with the time in the menstrual cycle and with pregnancy.

Cervical mucus is an important constituent of the normal vaginal discharge but some of it lies in the cervical canal to form a 'plug' which provides functional closure of the cervix. This plug prevents vaginal bacteria from invading the uterus by its mechanical and, probably, bacteriolytic properties.

The junction of the squamous epithelium covering the vaginal cervix and the columnar epithelium of the endocervix is normally situated at the external os. It is usually sharply defined by an abrupt change in cellular type but there may be a transitional zone 1-10 mm in width with variable histological features.

CHANGES IN THE UTERUS WITH AGE AND PARITY

In children, the cervix is longer than the corpus uteri, the proportions being 2:1. At one stage in intrauterine development the proportions are 5:1 or 6:1. At and after puberty, however, the corpus grows faster than the cervix and the latter represents only one-third of the total length

of the mature uterus; indeed, it is sometimes only one-quarter of the parous uterus. After the climacteric the uterus atrophies, its overall length is reduced and its walls become thinner, less muscular, and more fibrous. The cervix shrinks so the vaginal portion no longer projects and the external os becomes more or less flushed with the vaginal wall.

THE POSITION OF THE UTERUS

The uterus is normally moderately mobile, its most fixed part being the supravaginal cervix where the strong supporting ligaments are attached. The fundus can therefore rotate round this point, and the degree of anteflexion and anteversion is influenced by the state of adjacent organs.

SUPPORTS OF UTERUS

The broad ligaments are peritoneal folds that extend laterally from the uterus and cover the adnexal structures. They have no supportive function.

Within the broad ligament, beginning just caudal to the uterine arteries, there is a thickening in the endopelvic fascia that attaches the cervix and upper vagina to the pelvic side walls, consisting of the cardinal and uterosacral ligaments (parametrium). The term **uterosacral ligament** refers to that portion of this tissue that forms the medial margin of the parametrium and that borders the cul-de-sac of Douglas. The term **cardinal ligament** is used to refer to that portion that attaches the lateral margins of the cervix and vagina to the pelvic walls. The cardinal and uterosacral ligaments, therefore, are simply two parts of a single body of suspensory tissue. The term parametrium refers to all of the tissue that attaches to the uterus (both cardinal and uterosacral ligaments). The uterosacral ligament portion of the parametrium is composed predominantly of smooth muscle, the autonomic nerves of the pelvic organs, and some intermixed connective tissue and blood vessels, whereas the cardinal ligament portion consists primarily of perivascular connective tissue and the pelvic vessels. Although they are often described as extending laterally from the cervix to the pelvic wall, in the standing position they are almost vertical as one would expect for a suspensory tissue. Near the cervix, they are discrete, but they ran out in the retroperitoneal layer to have a broad, if somewhat ill-defined, area of attachment over the second, third and fourth segments of the sacrum. These ligaments hold the cervix posteriorly in the pelvis over the levator plate of the pelvic diaphragm.

The cardinal ligaments lie at the lower edge of the broad ligaments, between their peritoneal leaves, beginning just caudal to the uterine arteries. They attach to the cervix below the isthmus and fan out to attach to the pelvic walls over the piriformis muscle in the area of the greater sciatic foramen. Although when placed under tension they feel like ligamentous bands, they are composed simply of perivascular connective tissue and nerves that surround the uterine artery and veins. Nevertheless, these structures have considerable strength, and the lack of a separate "ligamentous band" in this area does not detract from their supportive role. They provide support not only to the cervix and uterus but also to the upper portion of the vagina (paracolpium) to keep these structures positioned posteriorly over the levator plate of the pelvic diaphragm and away from the urogenital hiatus.

THE RELATIONS OF THE UTERUS

Anterior to the uterine fundus lies the superior surface of bladder and vesicouterine pouch with its contents (Fig. 3.3). The cervix is adjacent to the posterior bladder dome and trigone. The rectouterine pouch and its contents lie posteriorly. The fallopian tube enter the uterus at the superior cornual region. The round ligament of uterus and ovary attach laterally, just below this level (Fig. 3.4). Lateral to the uterine body and fundus lie the broad ligament and uterine vessels.

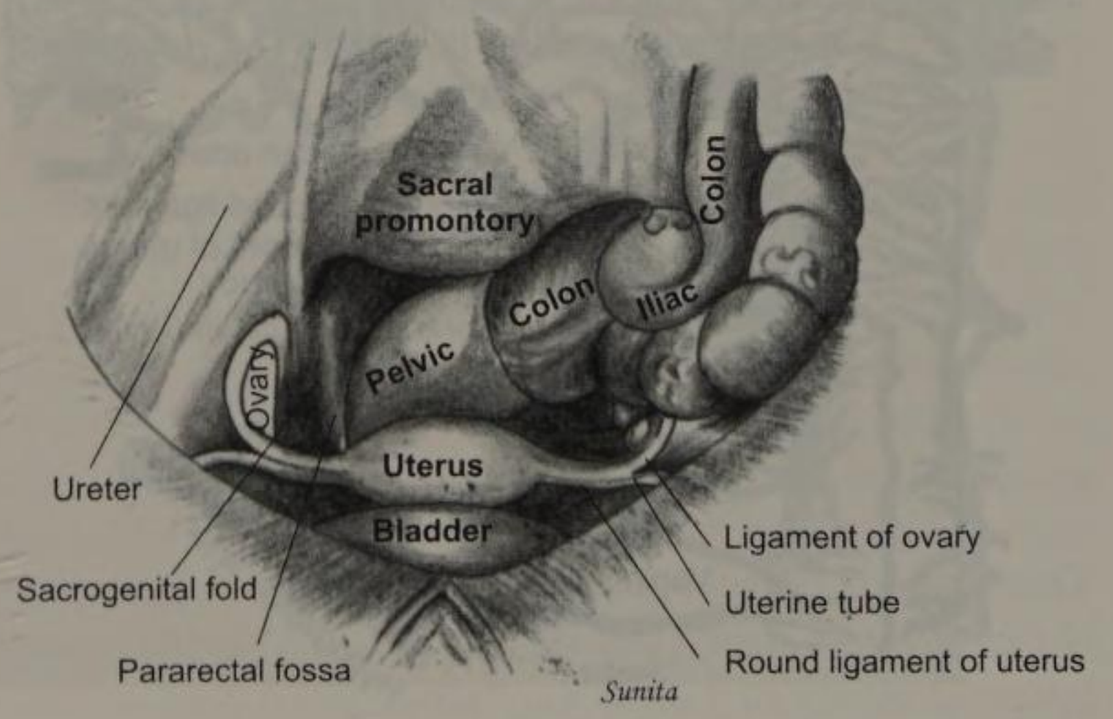

Fig. 3.3: Superior surface of uterus

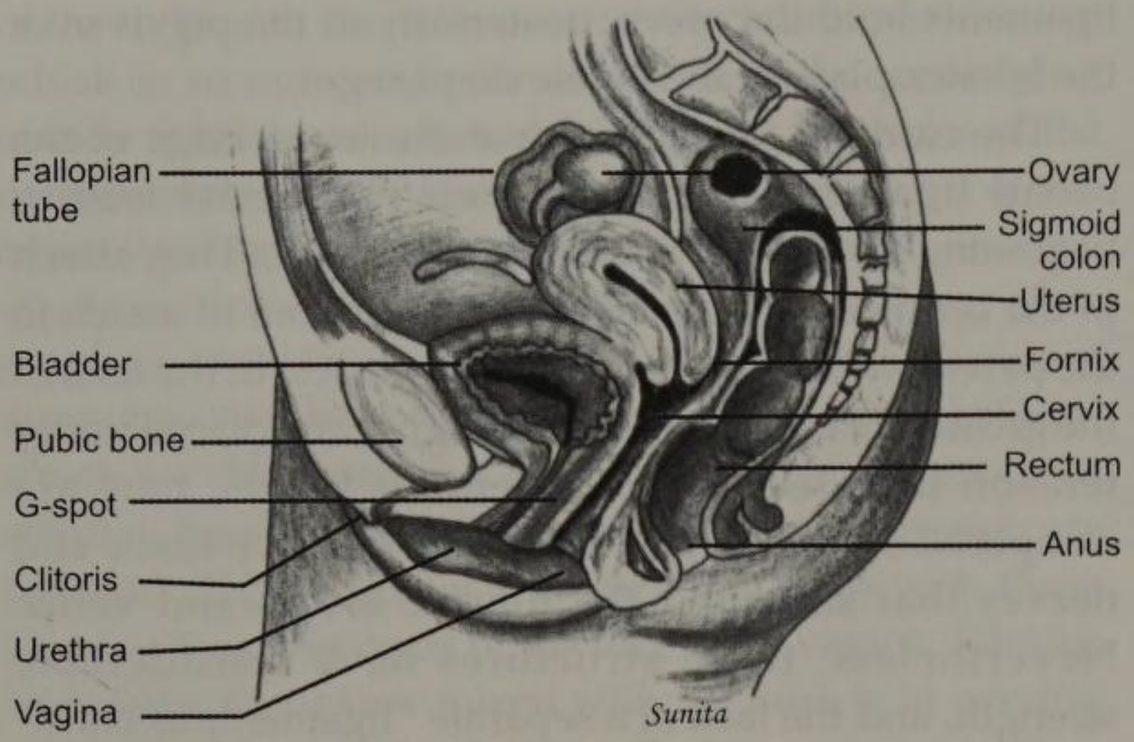

Fig. 3.4: Relations of uterus and cervix

VASCULAR CONNECTIONS

Arterial (Fig. 3.5)

1. Uterine artery
2. Ovarian artery.

Venous

1. Pampiniform plexus in broad ligament
2. Uterine vein
3. Ovarian vein
4. Vaginal plexus
5. Vertebral plexus.

The uterine artery originates from the internal iliac artery. It usually arises independently from this source but can have a common origin with either the internal pudendal or vaginal artery. It joins the uterus near the junction of the corpus and cervix, but this position varies considerably, both with the individual and the amount of upward or downward traction placed on the uterus. Accompanying each uterine artery are several large uterine veins that drain the corpus and cervix.

On arriving at the lateral border of the uterus (**after passing over the ureter and giving off a small branch to this structure**), the uterine artery flows into the side of the marginal artery that runs along the side of the uterus. Through this connection it sends blood both upward towards the corpus and downwards to the cervix. Because the marginal artery continues along the lateral aspect of the cervix, it eventually crosses over the cervicovaginal junction and lies on the side of the vagina.

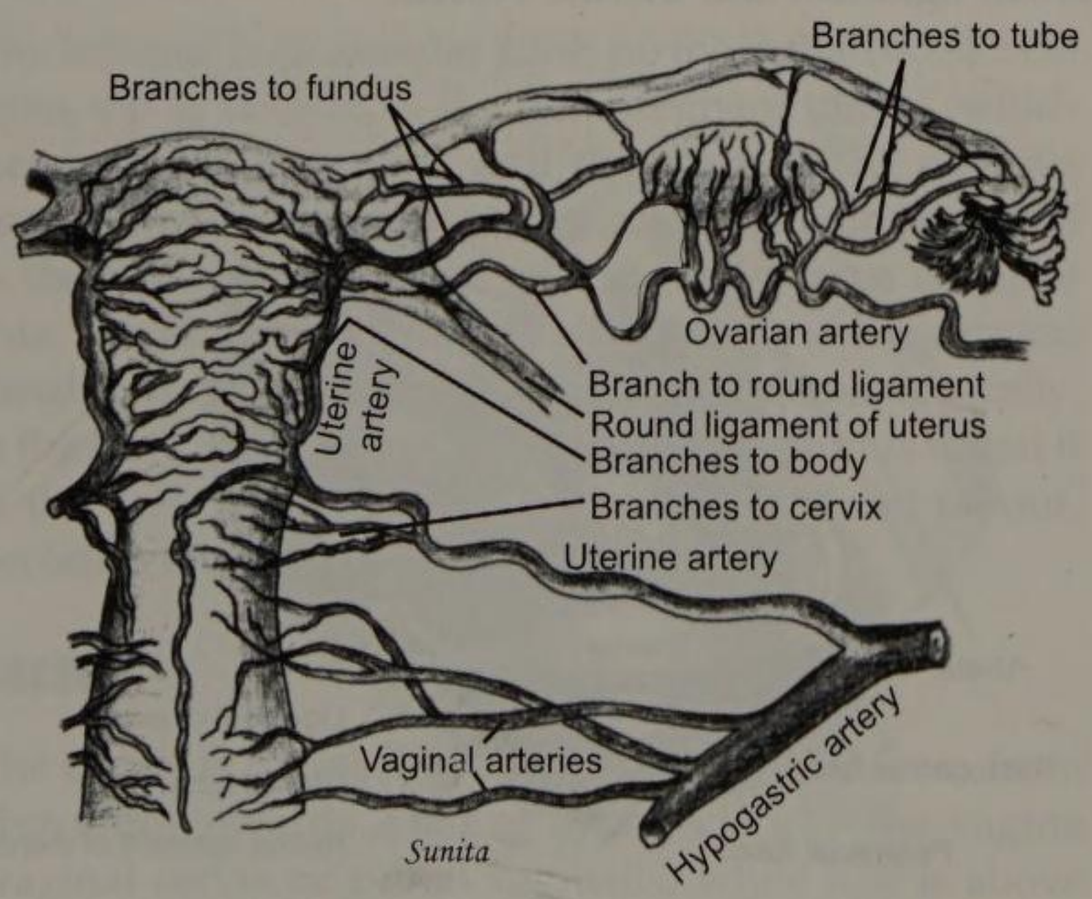

Fig. 3.5: Vascular supply of uterus and cervix

LYMPHATIC

Cervix

1. Paracervical plexus
2. Obturator nodes
3. External iliac and internal iliac (hypogastric) nodes
4. Sacral nodes.

Corpus

The same as the cervix. Also the aortic nodes (via lymphatics accompanying the ovarian vessels) and the superficial inguinal nodes (via lymphatics in the round ligament).

CLINICAL CORRELATIONS

1. The cervical transformation zone is that area of the ectocervix which undergoes metaplasia of epithelium from glandular to squamous – extending from the original to current squamocolumnar junction – is the area at greatest risk of development of premalignant and malignant squamous lesions. Cervical conization and a variety of ablative procedures address this disease by removing the epithelium at risk.
2. Sutures are often placed in the lateral cervix to encircle the cervical branch of uterine artery and reduce blood loss from cervical surgery.
3. Epithelial (Nabothian) inclusion cysts of cervix result from traumatic invagination of the surface epithelium, and generally therapy is not required.

4. The endocervix is lined with abundant parasympathetic nerve endings. Transcervical manipulation of the cervix, as with an endocervical curettage or endometrial biopsy, can stimulate these nerves and lead to a vasovagal reaction. A vasovagal reaction is characterized by hypotension with concurrent bradycardia. Management is usually only supportive care and reassurance. On rare occasions, measures such as atropine or smelling salts may be necessary to resuscitate the patient.
5. Acquired uterine retroversion may signify malignant or inflammatory disease posterior to the uterus. Uterine retroposition may also predispose to pelvic entrapment if the uterus enlarges (e.g. as in leiomyomata or pregnancy.)
6. Ablation of sensory nerves from uterus and adnexae that intermingle with the autonomic pelvic nerves (the presacral neurectomy) has been reported to provide symptom relief. Because of proximity of the hypogastric nerves to sacral vessels, hemorrhage may result from their interruption.
7. Laparoscopic uterosacral nerve ablation (LUNA procedure) has likewise been reported to provide relief of chronic pain. Because of its adherence to the lateral surface of the uterosacral ligament, the ureter is prone to injury. Great care must be taken to avoid damage to the ureter during this procedure. Ablation should involve only the medial most portion of the ligament.
8. Hemisection of the uterus in the sagittal plane (morcellation) is performed to aid difficult vaginal hysterectomy. The midsagittal plane is used most frequently, to minimize hemorrhage from the uterine artery at the lateral margin of the uterus.
9. Perforation of the uterine corpus in the midline at the time of dilatation and curettage may lead to peritonitis but rarely to hemorrhage. Perforation of the lateral corpus or cervix may produce broad ligament hematoma, secondary to damage of the laterally positioned uterine vessels. Perforation of the anterior cervix may penetrate the bladder, especially when the bladder is full. Avoidance of vesical damage is one of the reasons that bladder drainage should usually precede pelvic operation. Posterior cervical perforation may penetrate the relatively fixed rectum.
10. In gynecology, descriptive anatomic names of pelvic organs are derived from the Latin roote. The surgical procedures undertaken on a given organ are named after the Greek root. Examples with the Latin/Greek meanings:
    - Vagina (sheath)/Kolpos (fold), as in colpectomy, colposcopy, and so forth.
    - Cervix (neck)/Trachelos (neck), as in trachelectomy.
    - Uterus (womb)/Hystera (womb). As in hysterectomy, hysteroscopy and so forth.

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4 Adnexa in Relation to Vaginal Surgery

Namita Grover, Shalini Rajaram

ANATOMY OF ADNEXA

Ovaries and fallopian tubes constitute the uterine adnexa. They are covered by a specialized series of peritoneal folds called the broad ligament. During embryonic development, the paired müllerian ducts and ovaries arise from the lateral abdominopelvic walls. They migrate towards the midline, and a mesentery of peritoneum is pulled out from the pelvic wall from the cervix upwards. This leaves the midline uterus connected on either side to the pelvic wall by a double layer of peritoneum.[1]

The Ovaries

The ovaries are homologous with the testes in the male. They are two nodular bodies, situated one on either side of the uterus in relation to the lateral wall of the pelvis, and attached to the back of the broad ligament of the uterus, behind and below the uterine tubes. The ovaries are almond shaped and are grayish-pink in colour, and present either a smooth or a puckered uneven surface. They are each about 4 cm in length, 2 cm in width, and about 8 mm in thickness, and weigh from 2 to 3.5 gm. Each ovary presents a lateral and a medial surface, an upper or tubal and a lower or uterine extremity, and an anterior or mesovarium and a posterior free border. It lies in a shallow depression, named the ovarian fossa, on the lateral wall of the pelvis; this fossa is bounded above by the external iliac vessels, in front by the obliterated umbilical artery, and behind by the ureter and internal iliac vessels.The obturator nerve crosses floor of the fossa. The exact position of the ovary has been the subject of considerable difference of opinion, and the description here given applies to the ovary of the nulliparous woman. During pregnancy the enlarging uterus pulls the ovary up into the abdominal cavity. After parturition, when the broad ligament is lax, the ovary takes up a variable position in the pelvis.[2] In the erect posture the long axis of the ovary is vertical but it shares in any movement of broad ligament and uterus. The *tubal extremity* is near the external iliac vein; to it are attached the ovarian fimbria of the uterine tube and a fold of peritoneum, the suspensory ligament of the ovary, which is directed upward over the iliac vessels and contains the ovarian vessels. The *uterine end* is directed downward towards the pelvic floor, it is usually narrower than the tubal, and is attached to the lateral angle of the uterus, immediately behind the fallopian tube, by a rounded cord termed the ligament of the ovary, which lies within the broad ligament and contains some non-striped, muscular fibers. The *lateral surface* is in contact with the parietal peritoneum, which lines the ovarian fossa; the *medial surface* is to a large extent covered by the fimbriated extremity of the uterine tube. The *mesovarian border* is straight and is directed towards the obliterated umbilical artery, and is attached to the back of the broad ligament by a short fold named the mesovarium. Between the two layers of this fold the blood vessels and nerves pass to reach the hilum of the ovary. The *free border* is convex, and is directed towards the ureter. The fallopian tube arches over the ovary, running upward in relation to its mesovarian border, then curving over its tubal pole, and finally passing downward on its free border and medial surface (Figs 4.1 and 4.2).

Epoöphoron (Parovarium; Organ of Rosenmüller)

The epoöphoron lies in the mesosalpinx between the ovary and the fallopian tube, and consists of a few short

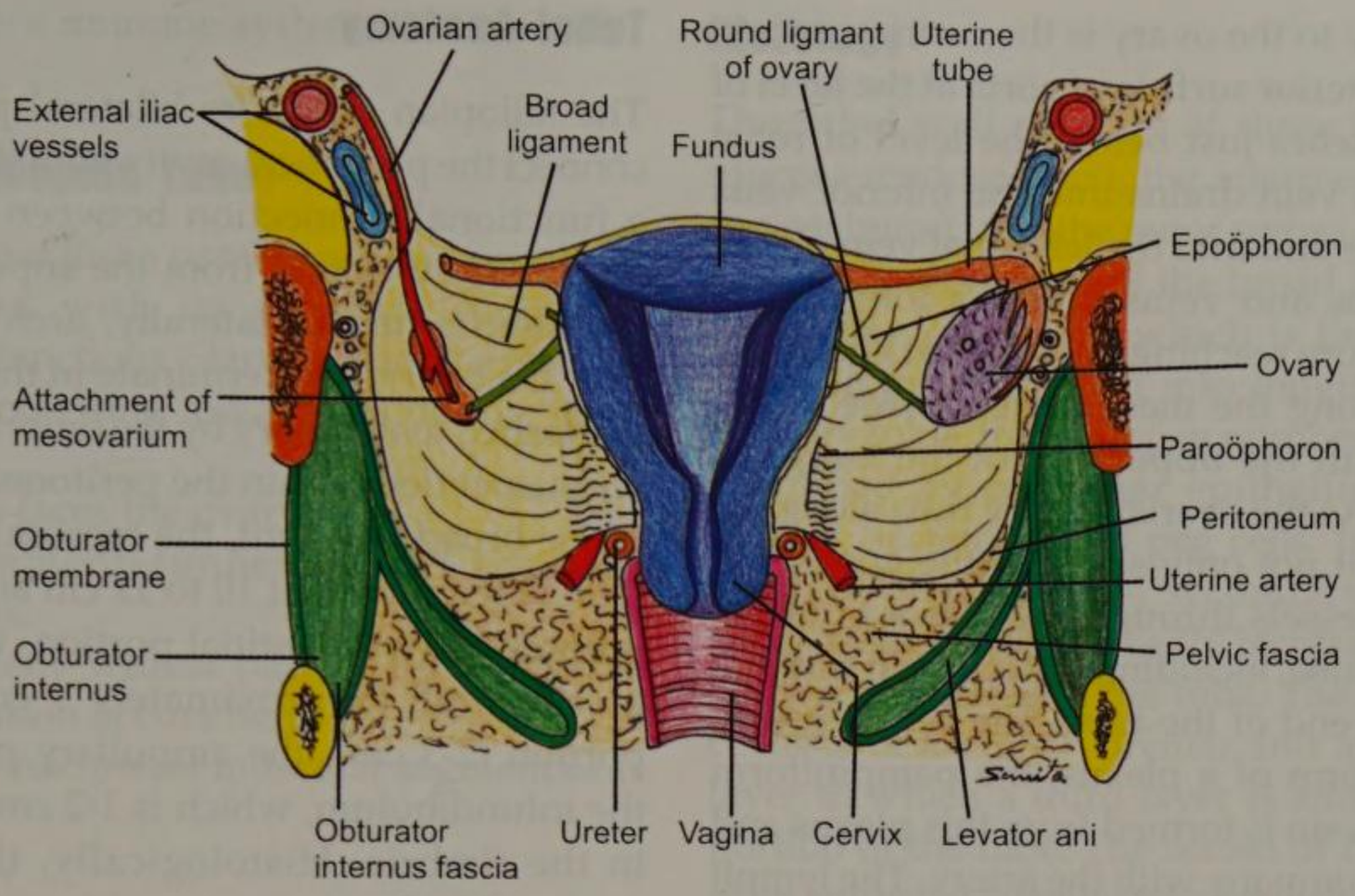

Fig. 4.1: Coronal section of female anatomical pelvis

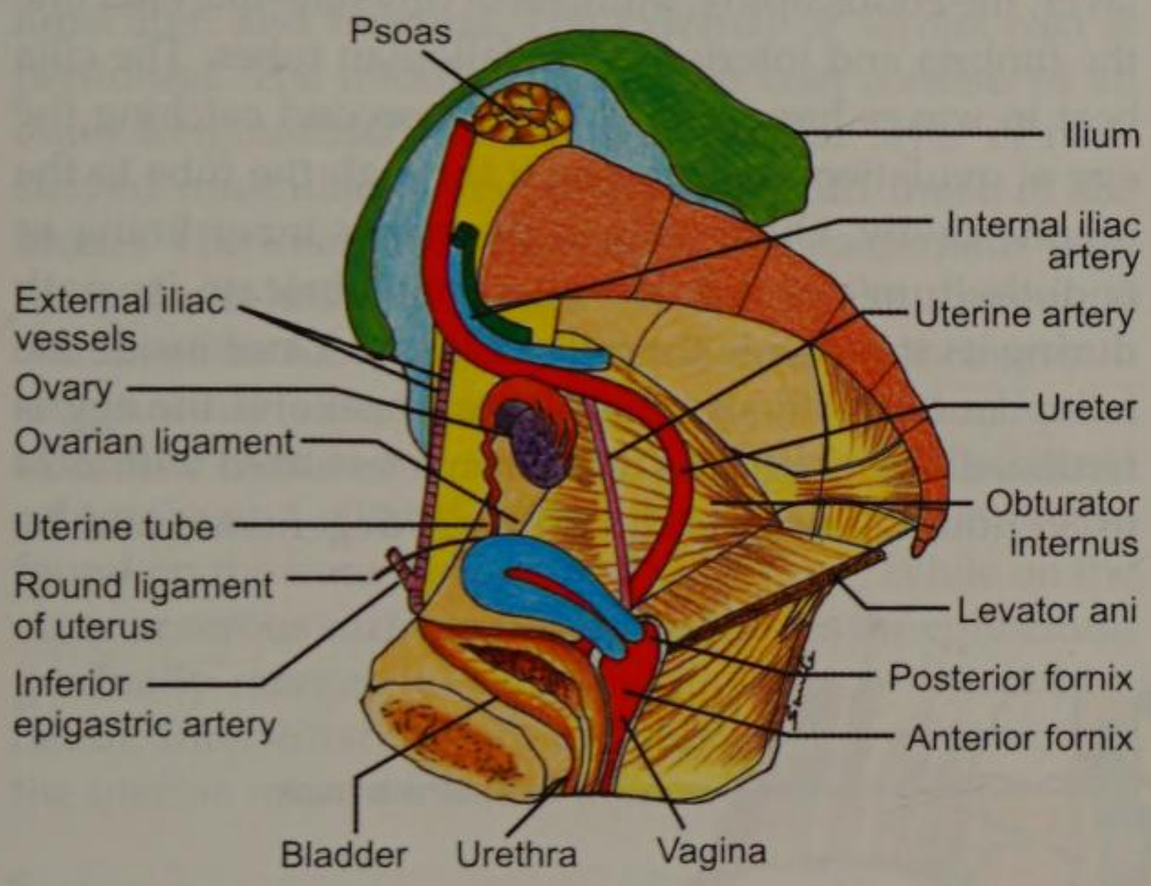

Fig. 4.2: Female anatomical pelvis

tubules (**ductuli transversi**) which converge towards the ovary while their opposite ends open into a rudimentary duct, the Gartner's duct.

Paroöphoron

The paroöphoron consists of a few scattered rudimentary tubules, best seen in the child, situated in the broad ligament between the epoöphoron and the uterus.The ductuli transversi of the epoöphoron and the tubules of the paroöphoron are remnants of the tubules of the Wolffian body or mesonephros; the Gartner's duct is a persistent portion of the Wolffian duct. In the fetus the ovaries are situated, like the testes, in the lumbar region, near the kidneys, but they gradually descend into the pelvis.

Structure

The surface of the ovary is covered by a layer of columnar cells which constitutes the **germinal epithelium of Waldeyer.** This epithelium gives to the ovary a dull gray color as compared with the shining smoothness of the peritoneum; and the transition between the squamous epithelium of the peritoneum and the columnar cells which cover the ovary is usually marked by a line around the anterior border of the ovary. The ovary consists of a number of vesicular ovarian follicles embedded in the meshes of a stroma or frame-work. The **stroma** is a peculiar soft tissue, abundantly supplied with blood vessels, consisting for the most part of spindle-shaped cells with a small amount of ordinary connective tissue. On the surface of the organ this tissue is much condensed, and forms a layer (**tunica albuginea**) composed of short connective-tissue fibers, with fusiform cells between them. Before puberty the ovary is smooth; but after puberty the ovary becomes progressively scarred as successive corpora lutea degenerate. After menopause the ovary becomes shrunken and the surface pitted with

scars. Arterial supply to the ovary is the ovarian artery, which arises from anterior surface of aorta at the level of the first lumbar vertebra just below the level of renal arteries. The ovarian vein drains into the inferior vena cava on the right side and into the left renal vein on the left side. The arteries and veins follow a long, retro-peritoneal course before reaching the cephalic end of the ovary. They pass along the mesenteric surface of the ovary to connect with the upper end of the marginal artery of the uterus. As the ovarian artery runs along the hilum of the ovary, it not only supplies the gonad but sends many small vessels through the mesosalpinx to supply the fallopian tube, including a prominent fimbrial branch at the lateral end of the tube. The veins emerge from hilum in the form of a plexus; the pampiniform plexus. The ovarian vein is formed from this plexus and leaves the plexus in company with the artery. The lymph vessels of the ovary follow the ovarian artery and drain into the para-aortic nodes at the level of the first lumbar vertebra.

The nerve supply to the ovary is derived from the hypogastric or pelvic plexus and aortic plexus and accompanies the ovarian artery (Fig. 4.3).The blood supply, lymphatic drainage, and nerve supply of the ovary pass over the pelvic inlet and cross the external iliac vessels. They then enter the lateral end of the broad ligament, the part known as the suspensory ligament of the ovary. The vessels and nerves finally enter the hilus of the ovary via the mesovarium.[2]

Tubal Anatomy

The fallopian tubes are bilateral pelvic structures that connect the peritoneal cavity with the exterior, providing a functional connection between the ovaries and the uterus. They extend from the superior lateral aspect of the uterine fundus laterally, arch posterior-superiorly over the ovary, and terminate in the fimbrial end, which is attached to the ovary by the fimbria. The fallopian tubes are suspended within the peritoneal cavity by a portion of the broad ligament, the mesosalpinx. The tube has a total length of about 10 to 12 cm and is divided into the intramural or interstitial portion, which lies within the uterine wall (approximately 1 cm long), the isthmic portion (2-3 cm), the ampullary portion (5-8 cm), and the infundibulum, which is 1-2 cm long and terminates in the fimbria. Histologically, the fallopian tube is composed of an outer serous layer, the serosa; a middle muscular layer, the myosalpinx; and an inner epithelial layer, the endosalpinx. Millions of tiny hair-like cilia line the fimbria and interior of the fallopian tubes. The cilia beat in waves hundreds of times a second catching the egg at ovulation and moving it through the tube to the uterine cavity. Other cells in the tube's inner lining or endothelium nourish the egg and lubricate its path during its stay inside the fallopian tube. Once inside the fallopian tube, the egg and sperm meet and the egg is fertilized. If an egg does not become fertilized within 24 to 36 hours after ovulation, it will degenerate and be

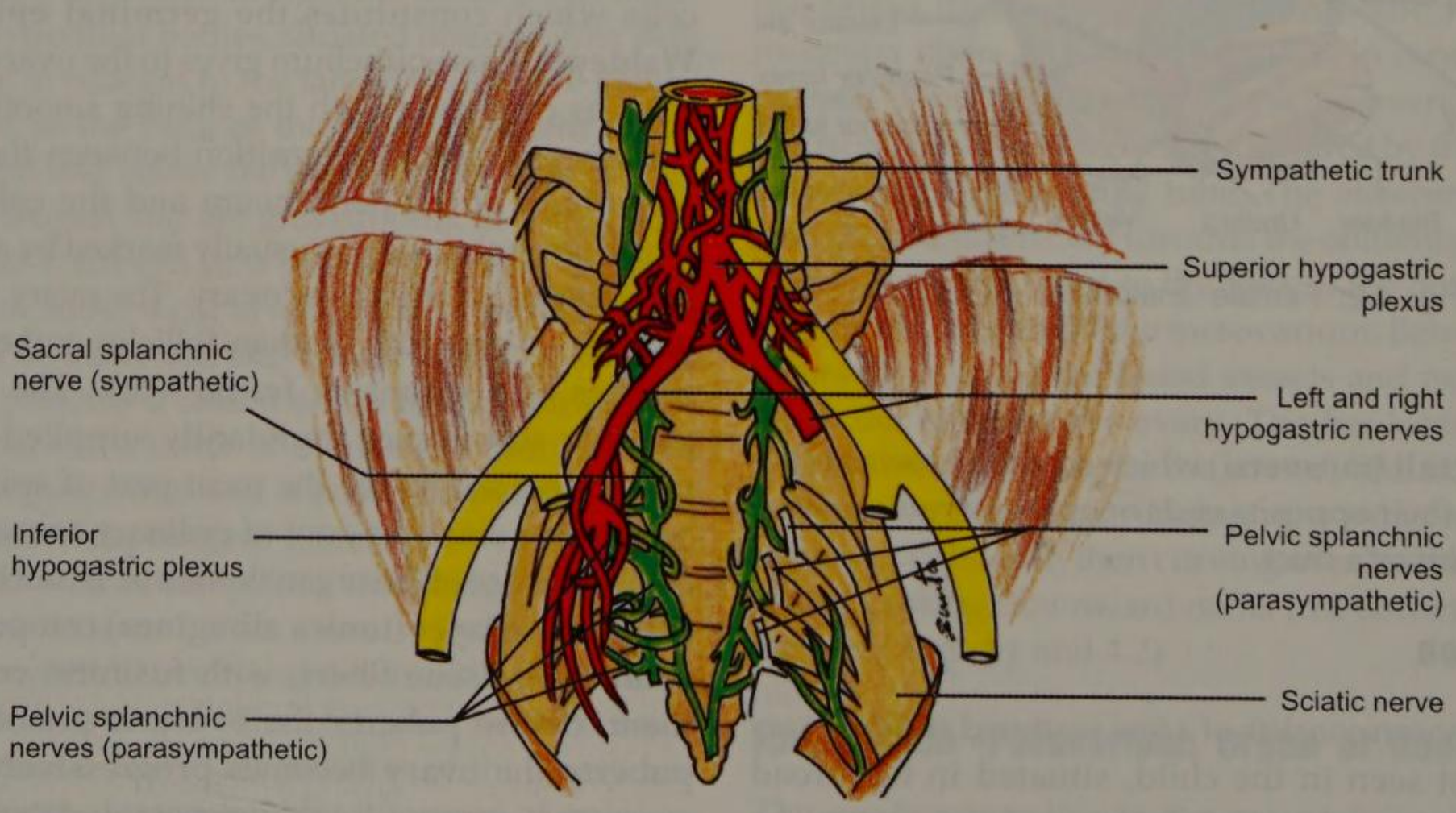

Fig. 4.3: Nerve supply of pelvis

removed by the body's immune system like any other dead cell in the body.

Segments of the Fallopian Tube

The fallopian tube is not just a passive pipe or a conduit, but an active organ with its separate segments performing different functions. Starting from the ovarian end (fimbria) and proceeding toward the uterus, these are the:

1. Fimbrial segment–faces the ovary.
2. Infundibular segment–funnel-shaped segment behind the fimbria.
3. Ampullary segment–widest part of tube (middle segment); fertilization occurs here.
4. Isthmic segment – narrowest muscular segment near the uterus.

Structure

The uterine tube consists of three coats—serous, muscular, and mucous. The external or serous coat is peritoneal. The middle or muscular coat consists of an outer longitudinal and an inner circular layer of non-striped muscular fibers continuous with those of the uterus. The internal or mucous coat is continuous with the mucous lining of the uterus, and, at the abdominal ostium of the tube, with the peritoneum. It is thrown into longitudinal folds, which in the ampulla are much more extensive than in the isthmus. The lining epithelium is columnar and ciliated. This form of epithelium is also found on the inner surface of the fimbriae. While on the outer or serous surfaces of these processes the epithelium gradually merges into the endothelium of the peritoneum. Interstitial/intramural segment passes through the uterine muscle into the uterine cavity.

Embryology

Between the fifth and sixth week after oocyte fertilization, a longitudinal groove called Müller's groove arises from the coelomic epithelium on each side lateral to the mesonephric duct. The edges of this groove fuse to form a canal called the Müllerian or paramesonephric duct. The Fallopian tubes develop from the cranial parts of the paramesonephric ducts, with their cranial ends remaining open connecting the duct with the coelomic (peritoneal) cavity and the caudal end communicating with the uterine cornua. Congenital anomalies of the tube include aplasia, in which the tube fails to form; hypoplasia, in which the tube is long, narrow, and tortuous; accessory ostia, and congenital diverticulae.

Histology

The tubal wall consists of three layers—the internal mucosa (endosalpinx), the intermediate muscular layer (myosalpinx), and the outer serosa, which is continuous with the peritoneum of the broad ligament and uterus, the upper margin of which is the mesosalpinx. The endosalpinx is thrown into longitudinal folds, called primary folds, increasing in number towards the fimbria and lined by columnar epithelium of three types—ciliated, secretory, and peg cells. In the ampullary and infundibular sections, secondary folds of the tubal mucosa also exist, markedly increasing the surface areas of these segments of the tube. The myosalpinx actually consists of an inner circular and an outer longitudinal layer to which a third layer is added in the interstitial portion of the tube. The serosa of the tube is composed of an epithelial layer histologically indistinguishable from peritoneum elsewhere in the abdominal cavity.

Vasculature

The intramural and isthmic portions are supplied by branches of the ascending uterine artery, while the ampulla, the infundibulum, and fimbriae are supplied by branches of the ovarian artery. The end branches of these arteries anastomose in the mesosalpinx. Occasionally, only one of the arteries supplies the entire fallopian tube, and then the endocrine status of the woman determines the width of the adnexal branches of the uterine cavity (Fig. 4.4). The venous drainage is parallel to the arterial supply and is achieved by both

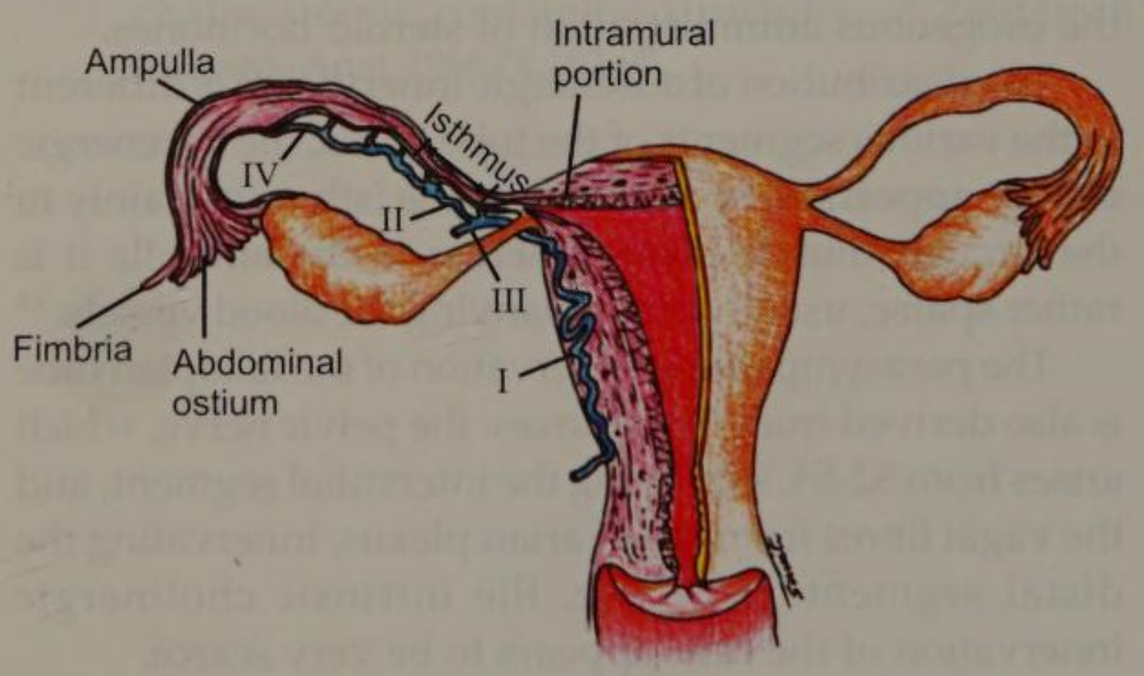

Fig. 4.4: Parts of fallopian tube and tubal vasculature: I—Ascending uterine artery, II—uterine artery branch supplying cornua and medial portion of tube, III—uterine artery branch anastomosing with ovarian artery, IV—Terminal portion of uterine artery branch anastomosing with tubal branch of ovarian artery

the uterine and ovarian veins. The well-developed blood supply ensures adequate perfusion of the fallopian tube.[3]

The lymphatic drainage of the human fallopian tube is separate from that of the uterus. The lymph vessels drain to the lumbar or para-aortic nodes together with the lymphatics of the ovary. Complex lymphatic networks drain the serosa, muscularis, and mucosa layers.

Innervation

Sympathetic innervation of the fallopian tube is derived from the hypogastric nerves and from the ovarian plexus. Sympathetic preganglionic fibres arising from T10-12 and L1-2 terminate in the inferior mesenteric ganglion. Postganglionic fibres from this ganglion pass through the hypogastric plexus and innervate the isthmus. Other sympathetic preganglionic fibres arise from T10- T11 and synapse in the celiac ganglia. Postganglionic fibres from these ganglia reach the ovarian plexus and supply the distal portion of the ampulla and the fimbria.[4] Apart from these postganglionic neurons, the hypogastric nerve also carries preganglionic fibres terminating in sympathetic ganglia at the uterovaginal junction. The postganglionic fibres from these ganglia are called "short" adrenergic neurons and innervate the uterus as well as the myosalpinx. These adrenergic neurons differ from the long adrenergic neurons in that they appear to have a lower discharge rate. In addition, they are particularly sensitive to the effect of steroid hormones, and this probably accounts for the fluctuation in noradrenaline levels during menstrual cycle and pregnancy, or after the exogenous administration of steroid hormones.

The distribution of adrenergic innervation is different in the various segments of the tube. Thus, the adrenergic supply appears to be very rich in the isthmus, mainly in the circular muscle layer, whereas in the ampulla it is rather sparse, usually accompanying the blood vessels.[5,6]

The parasympathetic innervation of the fallopian tube is also derived from two sources: the pelvic nerve, which arises from S2-S4, supplying the interstitial segment, and the vagal fibres from the ovarian plexus, innervating the distal segment. However, the intrinsic cholinergic innervation of the tube appears to be very scarce.

Surgical Aspects for the Vaginal Surgeon

The greatest fear of the vaginal surgeon is access to the adnexa for removing vaginally. Vaginal hysterectomy with adnexectomy is thought to be a risky and difficult procedure. Certain factors which seem to foster this perception are fear of restricted access to the ovaries, inadequate visibility of adnexa during conventional vaginal surgery, ureteric injury, blood loss and loss of ovarian pedicle necessitating abdominal exploration. If however knowledge of anatomy as described above, reasonable mobility of adnexa, proper instrumentation and technique is given due diligence this aspect of vaginal surgery can be mastered.

The prerequisities for oophorectomy or salpingo-oophorectomy vaginally are:

1. Easy access to the tube.
2. Mobile ovaries with long and free infundibulo-pelvic ligaments.
3. Benign nature of adnexa.
4. Mass freely mobile, size < 10 cm.
5. Clinical and ultrasound evaluation of mass.
6. Normal CA-125 in patients with enlarged ovaries.
7. No evidence of malignancy on the surface of ovaries.
8. Efficient retraction and lighting.
9. Experience of vaginal surgery.

Contraindications for oophorectomy or salpingo-oophorectomy are:

1. Extensive adhesions (pelvic inflammatory disease, endometriosis).
2. High immobile ovaries.
3. Atrophic mesovarium.
4. Tuboovarian masses.
5. Previous abdominal/genital Kochs.
6. Complex ovarian masses (thick septa, echogenic areas, papillary excrescences).
7. Difficulty in access and limited vaginal capacity.

Prior to surgery a thorough history taking and clinical examination of the patient is done. Assessment of uterine size, mobility and evaluation of adnexa is done. All patients undergo a transvaginal sonography (TVS) to assess size of uterus in three-dimensions and to evaluate ovarian size and echotexture is done. Enlarged cystic ovaries are assessed with respect to the following parameters during TVS; ovarian volume, any echogenic foci, papillary excrescences, thickness of septae and unilaterality or bilaterality.

Finally once the decision to remove either the ovary or the adnexa vaginally is made, the following grading is done intraoperatively to assess descent of the ovaries. The detailed techniques of removal are addressed by Sheth S and Kriplani A in Chapters 43 and 44.

GRADES OF DESCENT OF OVARY

Descent of the ovary is graded according to the position of the ovary in relation to vagina after stretching the infundibulopelvic ligament.

Grade 0 No descent, Infundibulopelvic ligament has little or no strechability, ovaries are positioned at the lateral pelvic wall at or above the ischial spines and cannot be brought with traction into the long axis of the vagina.

Grade I Infundibulopelvic ligament stretchability brings the ovaries into a long axis plane of the vagina with traction halfway between the ischial spines and midvagina.

Grade II Infundibulopelvic stretchability brings the ovaries into the long axis of the vagina with traction between the midportion of the vagina and the hymenal ring.

Grade III Infundibulopelvic stretchability brings the ovaries into the longitudinal plane of the vagina with traction past the hymenal ring.

In Grade 0 the adnexa must be approached laparoscopically, grade I-III can be approached safely vaginally.

CONCLUSIONS

Abdominal surgery has always played a role of great importance in management of adnexa be it normal or abnormal. Recently, this has undergone a revolution in which traditional laparotomy has to a great extent been replaced with minimally invasive methods, namely transvaginal approach along with laparoscopy. Such innovative means have aroused keen interest in the possibility of resolving some surgical issues without resorting to opening the abdomen. Also shorter operative time, decreased postoperative morbidity, shorter hospital stay and faster return to normal activities are great advantages of vaginal surgery. Also cost is a fraction of the more expensive laparoscopic surgery. Thus, resources should be directed towards development of technology and experience in the transvaginal management of adnexal pathology.

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5 Applied Anatomy of Ureter in Relation to Vaginal Surgery

Shalini Rajaram, Sandhya Jain

INTRODUCTION

Few complications of gynecologic surgery create more anxiety and medico-legal concerns than lower urinary tract injuries. The increasing repertoire of gynecologic surgical procedures emphasizes the importance of understanding anatomy to prevent and manage lower urinary tract misadventures. When complications occur, it is paramount to recognize and treat them appropriately. Gynecologists should manage their own complications. Unusual or complex complications may require a surgical colleague to help manage the problem, but this does not exonerate the primary surgeon from responsibility when problems develop.

Urinary tract injuries are still regularly described in case reports. The advent of newer, minimally invasive techniques, more aggressive urinary incontinence procedures, and pelvic floor reconstructive procedures may be associated with increased lower urinary tract injuries. Prevention and early recognition of injuries can only be achieved with diligent study of anatomy, superior training, and constant vigilance.

Embryology

The urethra, bladder and pelvic portion of the ureters represent the lower urinary tract portion of the urogenital system. At the fifth week of development, when the mesonephric ducts from above join the cloaca below, the ureteric buds arise from posterolateral wall of each mesonephric duct.[1] Each ureteric bud elongates and develops into a ureter that eventually fuses with the developing metanephros (kidney) on the same side. Because of the close relation between the genital and urinary tracts, an abnormality or disease of one system, such as congenital malformations, anatomic variants, infection, neoplasm or injury can affect the function of the other system. When significant parts of one or both müllerian ducts are missing (e.g. congenital absence of vagina and uterus) or obstructed, major anomalies of upper urinary collecting system are found in 35 to 40% of patients.

In avoiding and managing ureteral injuries, the gynecologic surgeon must be aware of the possibility of anomalous development of the upper urinary collecting system, e.g. duplex kidney, bifid kidney, double ureters, etc.

Anatomy

The ureter plays an important part in gynecologic operations. The ureter leaves the kidney between the level of the second and fourth lumbar vertebrae. It measures about 25 to 30 cm in length and is divided into abdominal and pelvic parts.[1] The abdominal ureter lies behind the peritoneum on the medial part of the psoas major and enters the pelvic cavity by crossing the bifurcation of the common iliac vessels. The pelvic ureter passes along the posterolateral pelvic wall, adjacent to the anterior border of the greater sciatic notch and slightly anterior to the hypogastric artery, until it reaches deep into the pelvis at the level of the ischial spine. In this area, the ureter lies medial to the branches of the anterior division of the hypogastric artery and lateral to the peritoneum of the cul-de-sac and uterosacral ligament. When the anatomy is normal, the ureter can usually be followed visually from the pelvic brim throughout its course beneath the peritoneum along the lateral wall of the true pelvis until it disappears beneath the uterine vessels and into the "tunnel" through the cardinal

ligament before entering the bladder. On the pelvic sidewall beneath the peritoneum, peristalsis can be seen in the ureter and this is helpful in its identification. Simply stroking the ureter longitudinally along its course can stimulate ureteral peristalsis. Deep in the pelvis, the ureter courses along the lateral side of the uterosacral ligament to enter the base of the broad ligament (the cardinal ligament). The ureter passes beneath the uterine artery about 1.5 cm lateral to the cervix at the level of the internal cervical os (Fig. 5.1). As the distal portion of the ureter approaches the bladder, it passes medially over the anterior vaginal fornix before entering the wall of the bladder just above the trigone. This angulation in the lower part of the ureter as it passes beneath the uterine vessels and turns to join the bladder is referred to as the knee of the ureter. At this point, the ureter is approximately 1.2 cm cranial to the vaginal vault.

The abdominal part of the ureter is regularly supplied by a branch directly from the abdominal aorta or by a branch of the renal or ovarian artery. At the level of the arcuate line (the point of the transition from the abdominal to the pelvic portion), the middle portion is generally supplied by branches of the common or internal iliac arteries, as well as branches from the uterine, middle rectal and internal pudendal arteries. In its upper and middle portions, the blood supply comes from the medial side. In contrast, the pelvic ureter receives its vascular supply principally from the lateral side. Dissection medially in this distal pelvic portion produces the least vascular damage. The periureteral tissues are also supplied by subperitoneal arteries. Thus, the ureters should be minimally dissected from their accompanying peritoneum. There are sufficient collaterals and anastomoses to ensure that an adequate blood supply to the ureter will remain in the event of hemorrhagic complication that require ligation or embolization of the internal iliac or uterine artery.

Surgical Anatomy in Relation to Vaginal/ Radical Vaginal Surgery

In radical vaginal hysterectomy, the aim is to retrieve part of the vagina and the parauterine tissues together with the uterus itself. The anterior and antero-lateral surfaces of the vagina and tissues adjoining the uterus are in close proximity to the bladder floor (and the ureters). The bladder and ureters are at risk of injury while opening the vesicovaginal space in the midline and the paravesical spaces on either side. The bladder pillars are located and divided after identification of the ureters. The posterior aspect of the specimen is freed when the rectal pillars are divided (a much simpler part of the operation).

Once the vaginal cuff is created, it is pulled down with instruments. Traction reveals the supravaginal septum (pubo-vesico-cervical ligament), a pseudo-membrane made by condensation of the connective tissue fibers joining the bladder floor to the vagina. Once the aponeurosis has been opened, the areolar tissue of the vesicovaginal space is visible and a tunnel can be made and enlarged to the level of the vesicovaginal peritoneal fold (Fig. 5.2). Next, the vesicovaginal space

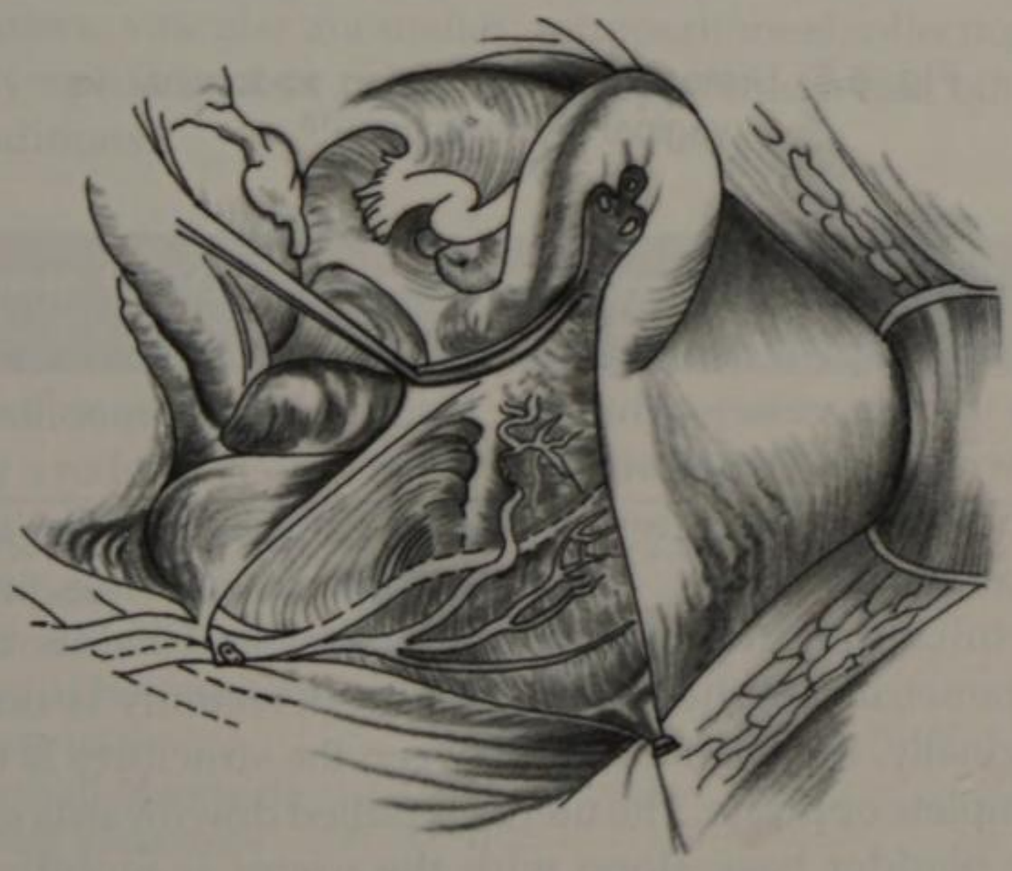

Fig. 5.1: Exposure of ureter during gynecologic procedure[15]

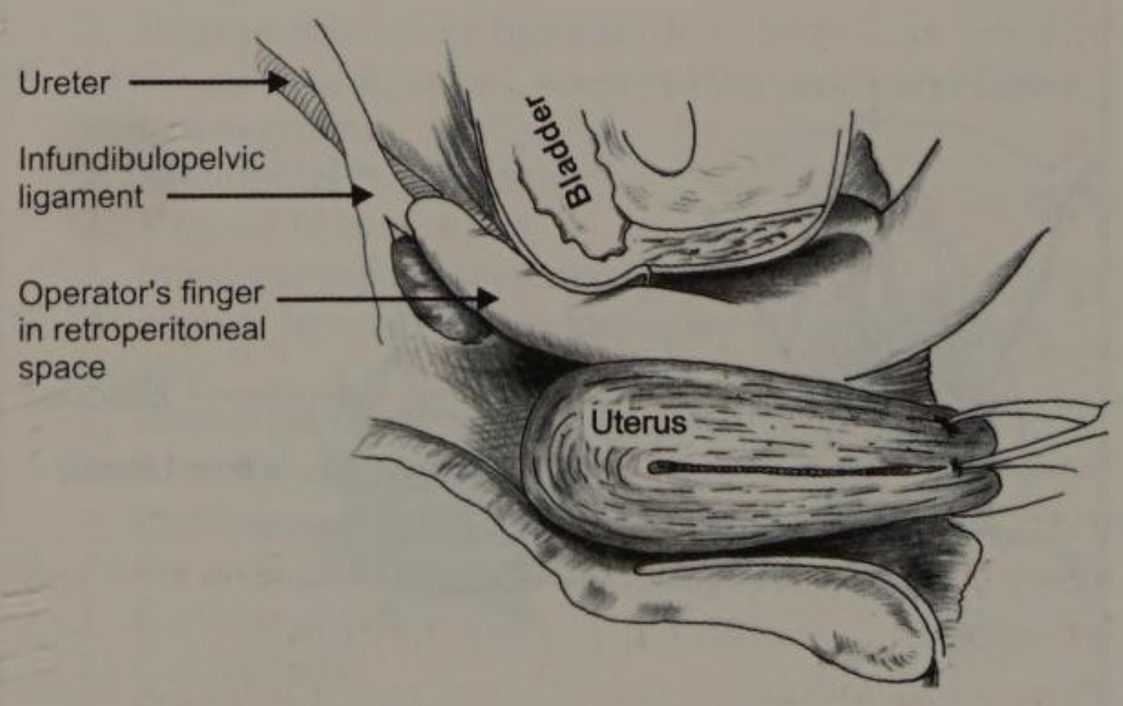

Fig. 5.2: Palpating the ureters through vesicovaginal peritoneal fold during vaginal hysterectomy[18]

is opened together with the paravesical space (Fig. 5.3). The paravesical space is reached by lateral dissection and a retractor is put in. The structure interposed between this retractor and the previously opened vesicovaginal space is the bladder pillar inside which the contour of the ureter can be identified while palpating the pillar against the retractor. The characteristic 'snap' of the ureter is evinced (Fig. 5.4).

Identification and Mobilization of the Ureter

A small retractor is placed in the left paravesical space and rotated under the symphysis pubis, pulling the bladder pillars and the bladder medially. The knee of the ureter is located on the lateral aspect of the bladder pillars, which act as pseudoligaments. The surgeon's right index finger is placed in the left paravesical space and the left index finger in the vesicouterine space. The surgeon's fingers are then pulled down gently until the 'click' is heard and the ureter is felt rolling under the fingers. To avoid damage, the ureter has to be seen and palpated unequivocally. The bladder pillars are stretched open and dissected midway between the bladder base and anterior aspect of the specimen carefully until the ureter is seen. The ureter is then freed laterally from its posterior attachment to allow mobilization upwards. This maneuver allows the ureter and the bladder base to be mobilized upwards as well.

It is of paramount importance to understand the relationship between the ureter, the uterine artery and the cardinal ligament and picture the relationship between the bladder base and lower uterine segment when performing radical vaginal surgery (Fig. 5.5). When a radical hysterectomy is done abdominally, the uterus is pulled upwards bringing with it the parametrium and the uterine vessels while the bladder base is mobilized downwards. Therefore, the uterine vessels lie above the concavity of the ureters as the ureters run into the parametrial tunnel to enter the bladder base. Thus, after mobilization, the ureters end lateral and below the parametrium. When the radical hysterectomy is done vaginally, the relationship between the structures is the complete opposite. The uterus is pulled downwards and the bladder base along with the ureter is mobilized upwards. As such, the uterine vessels end below the

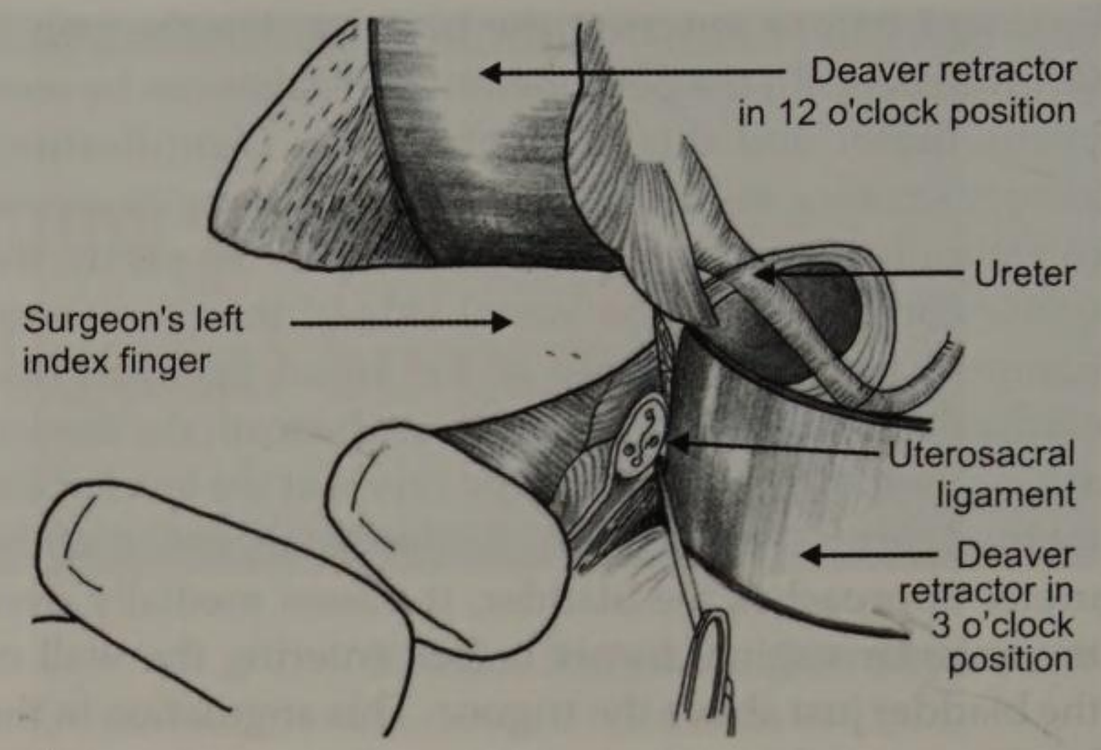

Fig. 5.4: The typical 'snap' felt while palpating the ureter between the finger and retractor[7]

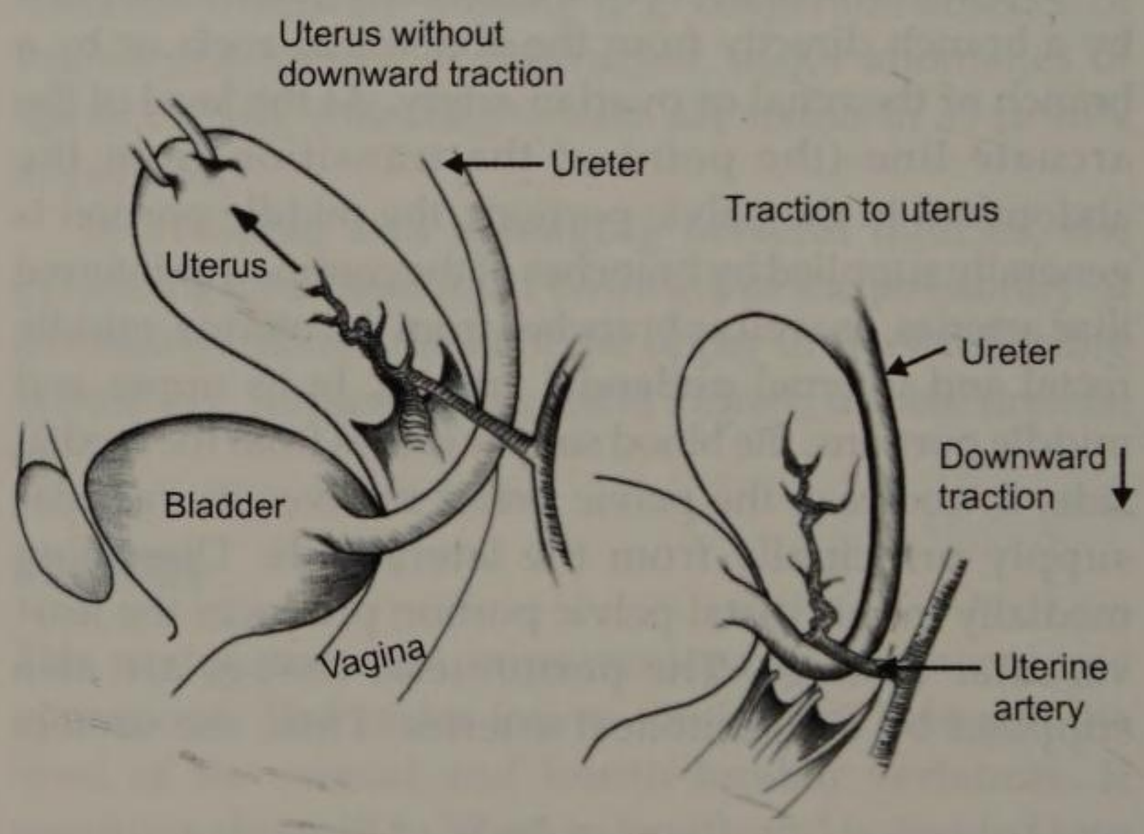

Fig. 5.5: Ureteral position during abdominal *vs* vaginal hysterectomy[18]

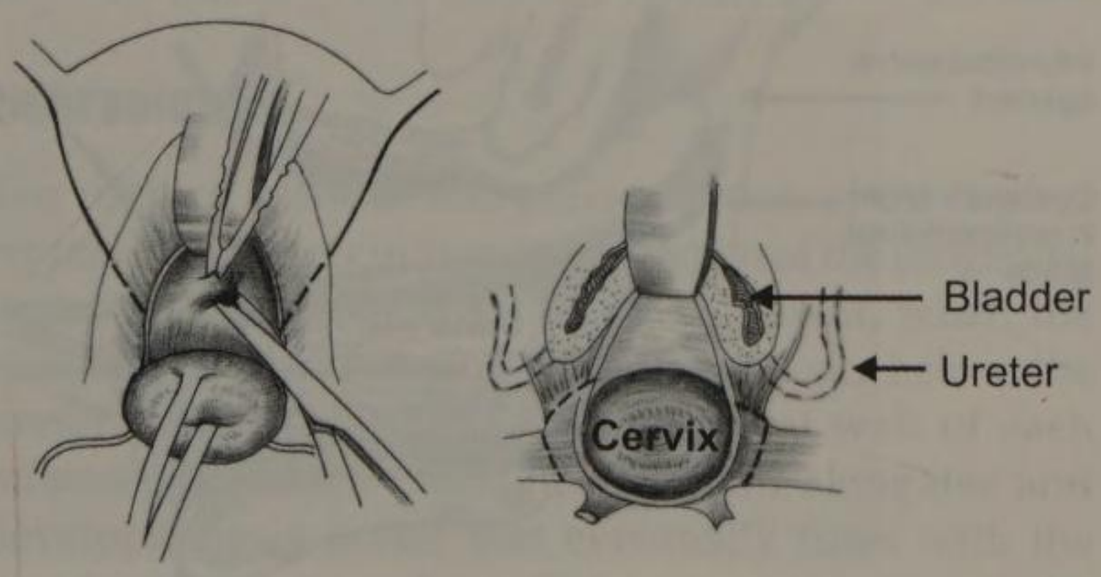

Fig. 5.3: Cutting the pubovesicocervical ligament and pushing up the bladder with a retractor[18]

concavity or the knee of the ureter and after mobilization the ureter courses above the parametrium.

Section of the Cardinal Ligament (Proximal Parametrium)

After opening the posterior cul-de-sac, the proximal aspect of the uterosacral ligament is excised. After careful re-identification of the ureter and the cross of the uterine artery, two curved clamps are used to secure the cardinal ligament. The first clamp is placed medially, and with gentle traction the second one is placed more distally to get wider parametrium, having the ureter safely mobilized upwards. The cervico-vaginal branch of the uterine artery is then identified at the level of the isthmus, clamped, excised and ligated. Care should be taken to identify and preserve the cross of the uterine artery.

Incidence of Injury and Conditions Making it Prone to Injury

Urinary tract injury complicates an estimated 1% of all gynecologic procedures and cesarean sections.[2] It is also estimated that gynecologic surgery accounts for 75% of all ureteral injuries and that 75% of these injuries occur during abdominal surgery (Table 5.1).[1]

In their course through the pelvis, the ureters are susceptible to involvement and compression by a variety of normal physiologic and pathologic conditions that affect the other structures and organs in the pelvis. These include pregnancy, benign and malignant tumors and diseases; vascular anomalies; retroperitoneal collections of lymph, blood or pus; organ displacement and other conditions.

Table 5.1: Gynecologic procedures associated with ureteral injury

Operative procedure	*Incidence of ureteral injury (%)*
Rutledge (Type III) Wertheim's hysterectomy	1.0-2.0
Abdominal hysterectomy	0.5-1.0
Vaginal hysterectomy	0.1
Adenexectomy	0.1
Marshall-Marchetti-Krantz procedure	< 0.1
Radical trachelectomy	Unknown
Radical vaginal hysterectomy	~10%

Large pelvic tumors, most commonly uterine leiomyomas and large benign or malignant, solid or cystic ovarian tumors, are often associated with ureteral obstruction by extrinsic compression. Especially notable are fibroids that arise in the cervix or lower uterus and cause direct compression of the bladder trigone and lower uterus. Marked dilatation of both ureters is uniformly present when complete procidentia has been chronic over the years. The obstruction lies where the ureters course beneath the uterine vessels and through the lateral cervical attachments; it may also be compressed against the medial margins of the levator hiatus and the subpubic arch. The lower urinary tract is at risk of surgical injury during most steps of major vaginal surgery: entering the anterior cul-de-sac, clamping and dividing the cardinal ligament, vascular pedicles, placing McCall sutures, accomplishing needle suspensions (dissection, placement of sutures, and passage of ligature carrier), placing plication sutures for anterior repair, and performing transvaginal bilateral salpingo-oophorectomy (Table 5.2).

The major types of operative traumas are crushing from misapplication of a clamp, ligation, transection, angulation with secondary obstruction, ischemia, resection, and laparoscopic injury by application of electrical, thermal or laser energy.

Table 5.2: Most common sites of ureteral injury and the procedures most commonly associated with each location (Fig. 5.6)

A. At the pelvic brim over bifurcation of common iliac artery
   1. Oophorectomy
   2. Lymphadenectomy
   3. Hypogastric artery ligation
B. In the cardinal ligament, lateral to the cervix and lower uterine segment
   1. Abdominal hysterectomy
   2. Vaginal hysterectomy
   3. Intraligamentary myomectomy
C. At vaginal fornices, just before entry of ureter into the trigone
   1. Retropubic bladder neck suspension
   2. Anterior colporrhaphy
   3. Paravaginal defect repair
D. At the level of the uterosacral ligaments
   1. Excision of pelvic mass
   2. Culdoplasty
   3. LUNA procedure
   4. Ablation of endometriosis
   5. Excision of ovarian remnant

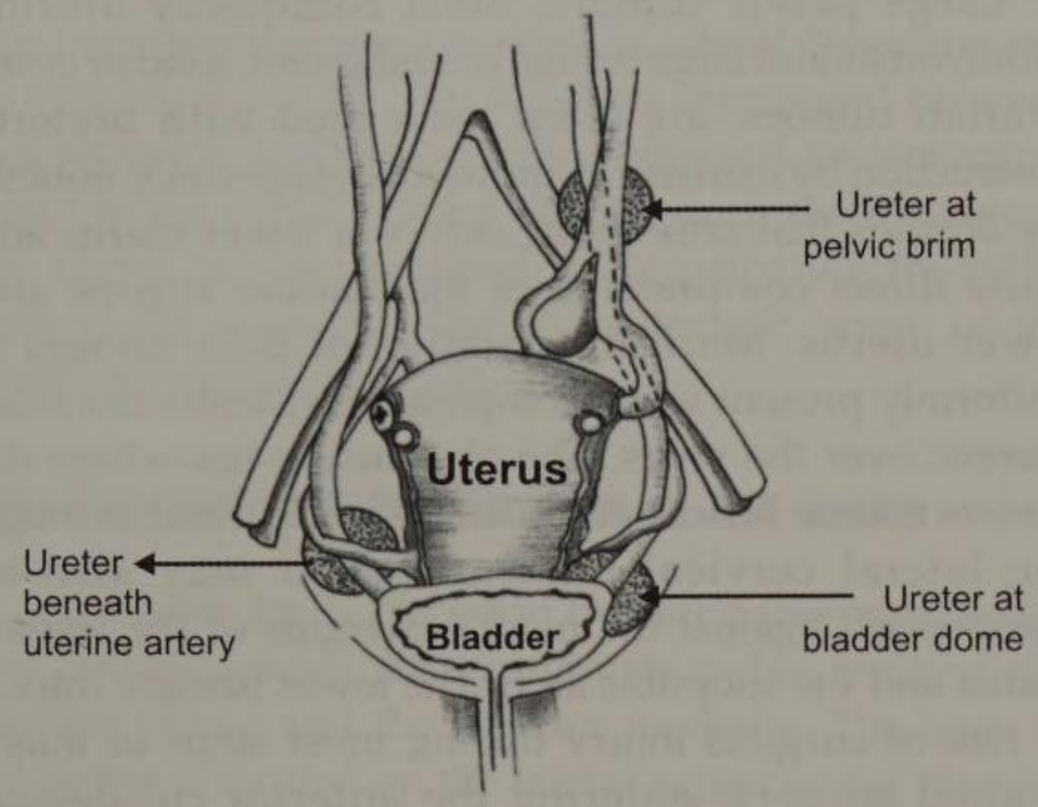

Fig. 5.6: Common sites of ureteral injury (anterior view)[32]

Most ureteral injuries involve the lowest 3 cm between the uterine vessels and the bladder. Most of these injuries are recognized during the procedure in which they occur.[3]

Prevention of Ureteric Injuries

Prevention of injury begins with a complete history and physical examination. Previous urologic problems, previous operations and current pathology will guide the surgeon in selecting preoperative testing. The best defense against injury to the urinary tract is knowledge of its anatomic relations and use of the avascular spaces of the pelvis to identify structures during surgery. This can be accomplished with good exposure through an adequate incision when operating abdominally, with careful visualization and dissection when operating laparoscopically, and with traction counter-traction and identification through palpation of structures when operating vaginally.

Preoperative Evaluation

Prevention of injury remains the primary goal of all pelvic surgeons. In addition to being aware of the anatomic relations of the ureter and bladder within the pelvis, one needs to be familiar with possible predisposing risk factors for urinary tract injury, including pelvic tumor, pregnancy, previous surgeries, endometriosis, tubo-ovarian abscess, complete procidentia, ovarian remnant, and bleeding or hematoma.[4] Routine preoperative imaging is not necessary, but one might consider an intravenous pyelogram (IVP) or contrast enhanced computed tomography if distorted anatomy is anticipated or previous urinary tract compromise is suspected. In a study by Piscitelli et al,[5] they concluded that uterine size of 12 weeks or greater and adnexal masses 4 cm or larger were the findings most likely associated with an abnormal study. Urinary embryologic anomalies, such as a duplicated system or horseshoe kidney can be documented but the incidence is only 7-10%. Thus, preoperative IVP in all patients is not a cost-effective strategy; also it does not dispel the surgeon's responsibility to dissect and identify the ureter in all pelvic operations.

The decision to place ureteral catheters before surgery should be made on individual basis. In a study by Kuno et al,[6] no statistically significant difference in the incidence of operative ureteral injury between the two groups was observed. In selected patients with indications such as multiple previous procedures and severe pelvic adhesive disease preoperative stenting of the ureters may offer an advantage by helping to identify and avoid injury to the ureters. Some cite no advantage in terms of injuries avoided for the routine use of stents on all patients and list possible complications, including urinary tract infection, ureteral spasm, reflex anuria, direct injury during catheterization, and hematuria.

Although many authors recommend use of routine intraoperative cystoscopy after high-risk urogynecologic or pelvic reconstructive surgery, there was no consensus concerning whether cystoscopy should be done after all major gynecologic surgeries.[7,8] Wiskind et al recommended the use of cystoscopy at every operation that places the ureter at risk. However, because of the proximity of the reproductive and lower urinary tracts, the ureters and bladder are at risk of injury in most major gynecologic operations. Another option is performing selective cystoscopy, only after complicated or difficult surgery, when the surgeon wishes to confirm the integrity of the lower urinary tract at the end of the operation. Routine cystoscopy does not guarantee recognition of all lower urinary tract injuries[10] and non-obstructive, partially obstructive, or late injuries secondary to ischemia and necrosis can also be missed.[11]

Intraoperative Evaluation

Vaginal hysterectomy, a favourite operation is being done more frequently because of changing indications,[12] patient comfort, and better techniques. Therefore,

knowledge of anatomy is critical. The ureter is pulled closer to the uterus than with abdominal hysterectomy and is in jeopardy if strict attention is not given to it during vaginal surgery.[13,14] Traditionally, emphasis has been placed upon prevention of ureteral injury.[15,16] Ureters are difficult to identify because they are small, and one needs a high index of suspicion in all types of pelvic surgery, both abdominal and vaginal. Recognition of injury when it occurs is second only to its prevention.

The best way to be sure of urinary tract integrity is to visualize the bladder and ureter fully. This takes the form of appropriate exposure, proper incision, assistants, patient position, lighting and retractors. Visualization and palpation of the ureter during pelvic surgery ensures proficiency and familiarity with the anatomy and an ability to approach complications when they occur.

Cruikshank and others have described techniques for performing this task, both vaginally and abdominally.[17,18]

The retroperitoneum is opened during abdominal pelvic surgery by either dividing the round ligament or by creating a window in the peritoneum between the round ligament and fallopian tube. Blunt dissection separates the loose areolar tissue from the pelvic vessels. The ureter is identified on the medial leaf of the broad ligament, tracing it cephalad and caudad. Squeezing the medial leaf of the broad ligament between the index finger and thumb, and slowly elevating it in a ventral direction produces a characteristic ureteral snap and guides visualization. Identification is important prior to clamp placement. During abdominal hysterectomy, the cardinal ligament is clamped halfway between the internal os and external os at right angles to the cervix. The next clamp should be straight and placed inside the previous pedicle. This practice prevents injury to the ureter as it passes through the cardinal ligament and frees it laterally, preventing injury. Clamps applied during vaginal hysterectomy are placed at right angles to the cervix, staying inside preceding pedicles. Caudal traction draws the ureter's "pelvic knee" downward with the blood supply. Releasing the vascular pedicle frees the ureter from the abdominal field.

During vaginal hysterectomy, or vaginal surgery for pelvic floor relaxation, the ureter can be identified in a similar manner. Downward traction of the uterine artery exerted by pulling on the cervix, in conjunction with upward traction on the entry point of the ureters into the trigone by a retractor placed under the bladder through an anterior colpotomy, puts tension on the ureter, forming a palpable structure: the "knee" of the ureter.[19] It is also possible, if needed to dissect out the ureter transvaginally.[18] Hofmeister[20] showed with fluoroscopy that the average distance from the ureter to the cervix in a normal sized uterus was 2.1 cm. During anterior colporrhaphy he showed the ureter to be only 0.9 cm from the surgeon's needle in the upper third of the vagina. Delancey et al[21] showed that the cervix descends in a three-to-one proportion in relation to the ureter in advanced uterovaginal prolapse. However, it was also shown that enough anatomic variation exists in this relationship that only palpation of the ureter in relation to clamp placement can ensure a margin of safety. After entry into the anterior and posterior cul-de-sac, the bladder should be elevated with a retractor and a finger used to explore the abdominal cavity. Palpate the ureter between the infundibular and hypogastric arteries pulses. Use this proprioceptive information to guide placement of atraumatic clamps on the peritoneal edge, tenting the tissue away from the pelvic sidewall. Incise the peritoneum 5 cm cephalad from the grasped peritoneal edge, exposing the retroperitoneum, similar to the abdominal approach. Careful blunt separation of the loose areolar tissue and firm lateral retraction will expose the ureter entering the bladder. Employ similar techniques while dissecting an enterocele sac in uterine absence. During plication of a cystocele, the ureters tend to be lateral and superior, but care should be taken not to be overzealous and place the stitches too laterally. During an aggressive central anterior colporrhaphy, the posterior bladder wall may become distorted, making cystoscopic visualization of the ureteric orifices difficult.

If perforation of the bladder is suspected, one can fill the bladder with methylene blue or indigocarmine mixed with saline and look for the leakage. A cystoscope or another endoscope can easily be used transurethrally or through the dome of the bladder to show bilateral ureteral patency and bladder during surgery at any operation, adding little time or cost to the original procedure. An analysis of universal performance of cystoscopy at gynecologic procedure by Vises et al[22] suggested that performing cystoscopy on every patient becomes cost-effective when ureteral injury rates exceed 1.5% for abdominal hysterectomy and 2% for vaginal or laparoscopically assisted vaginal hysterectomy.

During an abdominal procedure if the patient cannot be repositioned for transurethral cystoscopy, bladder telescopy can be performed by introducing an endoscope through a purposeful, extraperitoneal cystostomy, as described by Timmons and Addison.[23] If ureteral patency

cannot be demonstrated by the above techniques, further steps must be initiated while the patient is still under anesthesia and the injury is fresh. Retrograde pyelography can be performed and the point of ureteral injury determined. If an injury is detected, retrograde stenting of the ureter can be attempted either cystoscopically, or if operating transabdominally, through a purposeful, extraperitoneal cystostomy. If stenting is successful, a double-J sent can be left in place and be removed with a cystoscope in the office 4 to 6 weeks after surgery.

Postoperative Recognition of Injury

As with all operative complications, the key to a good outcome is early recognition and treatment. If any urinary tract injury is suspected in the postoperative period, it is always important to perform an IVP to exclude injury to the upper tracts. A retrograde study may be more useful in identifying the point of injury because the obstructed ureter may be slow to fill on antegrade IVP and the actual point of obstruction may be difficult to see secondary to the dilution of the contrast material in a post obstructive hydroureter. Renal ultrasound may reveal hydronephrosis or hydroureter.

The ureter can be injured in many different ways. It may be accidentally ligated, kinked, transected, crushed, cauterized or devascularized. Different types of ureteral injuries have different presenting symptoms as well as different management considerations. Postoperative signs of ureteral ligation may include flank or pelvic pain, pyelonephritis and sepsis, abdominal swelling secondary to collection of urine (urinoma), or development of a ureterocutaneous fistula. In some of these patients "silent" kidney failure occurs with no associated signs or symptoms.

Patients with unilateral ureteral obstruction maybe noted to have a transient increase in their serum creatinine levels in the first 24 to 48 hrs.[24,25] However, a normal postoperative serum creatinine level does not preclude an injury.

Continuous leakage of urine into the operative site after ureteral transection increases the likelihood of being detected during the operation. Hematuria may also occur after transection but cannot be considered a reliable sign of ureteral damage. Transection of the ureter may result in either a pelvic urinoma or ureterocutaneous fistula.

A continuous postoperative watery vaginal discharge is suspicious for vesicovaginal or ureterovaginal fistula. A urinary fistula should also be suspected if laboratory analysis of the fluid draining from a surgical wound or drain shows a higher concentration of creatinine than found in the patient's blood sample.

Extensive retroperitoneal dissection of the ureter many injure its adventitial vascular supply, with subsequent postoperative necrosis of the devitalized segment. This risk is greatest in cancer surgery.

Management of Ureteric Injuries

Management of ureteric injuries depends on the time of recognition, site and nature of the injury. All injuries discovered intraoperatively should be repaired immediately. Management of injuries discovered postoperatively is controversial. The question is whether to operate immediately or to perform a nephrostomy and allow edema and inflammation to subside first. Many authors favor immediate repair[26-29] because of the high chance for satisfactory outcome. Lee and Symmonds[30] appropriately note, however that the timing of operation depends on the overall clinical assessment of the nature and extent of the injury as well as the general condition of the patient. All authorities caution that prolonged delay is neither necessary nor desirable (Table 5.3).[31]

Injury to the ureter can be defined as crushing, ligating or kinking. An injury caused by a clamp should be relieved immediately. If the ureter returns to its normal peristaltic activity and color remains normal, a stent should be passed and IVP checked in 10 days. If the system appears normal, the stent can be removed. If ureteric damage seems present or the ureter is cut or ligated, perform a reanastomosis or direct implantation. The choice of repair depends on the location of the injury. When the ureter is injured below mid-pelvis, a ureteroneocystostomy, or ureteral reimplantation is most

Table 5.3: Principles of ureteral repair

1. Meticulous ureteral dissection preserving adventitial sheath with its blood supply.
2. Tension-free anastomosis by ureteral mobilization.
3. Use minimal amount of fine absorbable suture to attain a watertight closure.
4. Use peritoneum or omentum to surround the anastomosis.
5. Drain the anastomotic site with a closed suction drain to prevent urine accumulation.
6. Stent the anastomotic site with a ureteral catheter.
7. Consider a proximal diversion.

commonly used. These injuries usually occur within 4 to 6 cm of the trigone. Tension free reimplantation is essential. To accomplish this additional bridging procedure such as a Psoas muscle hitch or Boari-Okerblad flap may need to be used.

When the injury occurs above mid-pelvis, there may not be enough proximal ureter left to reach the bladder for reimplantation. At this point, a uretero-ureterostomy or end-to -end anastomoses of the injured ureter becomes the best option. The ends of the ureter are spatulated to decrease the chances of stenosis occurring at the anastomotic site. An omental fat graft can be helpful to aid healing by providing an additional blood supply.

When an injury occurs such that a short proximal ureter exists, it may not be possible to reanastomose the ureter to itself. In such a case a transureteroureterostomy or end-to-side anastomoses of the proximal ureter to the contralateral ureter may be required. This should be avoided, if possible because stenosis at this anastomotic site could now jeopardize function in both the kidneys. If the above options are not possible or the resources to execute them are not immediately available, a single J-stent can be inserted into the proximal end of the cut ureter and can be brought out to the skin into a collecting device. Thus, the short ureter is able to drain, but is not dissected until repair is possible. This is a temporizing measure to preserve renal function while the patient awaits definitive repair.

CONCLUSIONS

Prevention and early recognition of ureteric injuries can only be achieved with diligent study of anatomy, better training and constant vigilance. Most ureteric injuries can be avoided, if preventive measures are undertaken, both before and during pelvic surgery. Adequate gynecological urologic training should be an integral part of obstetrics and gynecology residency programs so as to enable the gynecologists to avoid and to deal with acute ureteric injuries in the absence of urologic surgeons.

Key Points

1. The increasing repertoire of gynecologic surgical procedures emphasizes the importance of understanding anatomy to prevent and manage lower urinary tract injuries.
2. Urinary tract injury complicates an estimated 1% of all gynecologic procedures and caesarean sections.
3. Gynecologic surgery accounts for 75% of all ureteral injuries and 75% of these injuries occur during abdominal cases.
4. Most ureteral injuries involve the lowest 3 cm between the uterine vessels and the bladder. Most of them are recognized during the procedure in which they occur.
5. In addition to being aware of the anatomic relations of the ureter and bladder within the pelvis, one needs to be familiar with the possible predisposing factors for ureteric injury and management.

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Section II

Preoperative Care, Operation Theatre, Sutures and Instruments

6

Current Concepts in Preoperative Care

Rashmi Malik

Preoperative care for women prior to gynecological surgery is essential to achieve successful outcome of surgery. Successful outcome of operative gynecological procedures occurs as the result of several factors in addition to good surgical skills and techniques. These factors include:

1. Appropriate preoperative evaluation (the ability to accurately assess and diagnose gynecological pathology, defect and injury).
2. Appropriate patient selection (the ability to determine when surgical intervention is a necessary course of action).
3. Appropriate selection of surgical procedure.
4. Appropriate discussion with the patient regarding the benefits and risks of surgery (the ability to communicate to the patient both short and long-term complications in a manner that can be understood).

Choosing the Best Treatment Option

Preoperative assessment begins in the outpatient department when the decision is made to undertake surgery. The gynecologist must weigh the nature of the disorder and the severity of symptoms and offer advice on medical and surgical options. A balanced view must be presented of the operation and the risks. Alternative treatments must be discussed with the patient to determine what is the most appropriate treatment given the wishes of the patient and her condition. Experienced decision making at this stage is essential to the success of the procedure and the patient's satisfaction of the outcome. Subsequent skilled surgery can only rarely compensate for a wrongly planned or inappropriate procedure on a poorly prepared patient.

Consent

It is fundamental that patient should have as clear an understanding as possible about the procedure she is about to undergo so that she may give her consent in the full knowledge of what the risks may be. For the consent to be valid in law, three conditions must be satisfied:

1. The patient must be competent to give consent.
2. Appropriate information must be received and understood by the patient.
3. The patient's consent must be voluntary and without coercion.

Adults over 18 years are generally presumed to be competent to make treatment decisions on their own behalf. Consent should be sought before the proposed procedure and before sedation is given. It should be discussed when the patient is not unduly stressed and when she has time to consider the information given.

Consent should always be taken by someone competent to ensure that information on all aspects of the procedure has been given and understood by the patient. It is preferable that the consent be obtained by the person who will carry out the procedure. The procedure for obtaining the consent must include an explanation of:

1. The procedure, its purpose and expected outcome.
2. Any alternatives to the treatment proposed.
3. An outline of the risks and benefits.
4. The consequences of refusing treatment.

Preoperative Evaluation and Planning

Once surgical intervention is thought to be the appropriate course of action, surgical planning should

be instituted. This includes preoperative evaluation to accomplish the following tasks:[1]

1. Decrease surgical morbidity.
2. Minimize expensive delays and cancellation on the day of surgery.
3. Evaluate and optimize patient health status.
4. Facilitate the planning of anesthesia and perioperative care.
5. Reduce patient anxiety through education.
6. Obtain informed consent.

Preoperative Evaluation

The importance of preoperative evaluation should not be underestimated. Preoperative patient conditions are significant predictors of postoperative morbidity. A thorough preoperative evaluation should strive to answer the following questions:[2]

1. Is the patient in optimal health?
2. Can or should the patient's physical or mental condition be improved before surgery?
3. Does the patient have health problems or use any medications that could unexpectedly influence perioperative events?

To answer above questions it is essential that all women undergoing preoperative assessment have a complete history and thorough physical examination as a key element in their work-up. This examination is important to determine factors that could affect surgical outcome. Where medical status questions arise that cannot be answered by the gynecologist, then laboratory testing and imaging procedures as well as consultations become important to promote optimal outcomes.

Laboratory Investigations

Prior to the era of evidence based medicine, most patients undergoing gynecological surgery were assessed by a thorough history and physical examination followed by a battery of laboratory tests, the purpose of which was to detect a medical disease or defect that could adversely affect surgical outcome. These tests were accomplished on almost all patients, irrespective of age or concurrent medical or surgical pathologies. Unfortunately, the use of multiple "routine" tests has resulted in considerable additional costs for surgery and has created a problem as to what should be done when preoperative test results are found to be unexpectedly abnormal. The greater the number of preoperative tests performed, the greater the probability of finding a false positive abnormal test result.

The data from the last two decades indicate that 60-70% of laboratory tests ordered preoperatively are not required based on a review of the history and/or physical examination.[3] Other studies suggest that only 1% or less of routinely performed preoperative tests reveal abnormalities that might influence perioperative management.[4] Furthermore, between 30-60% of all unexpected abnormalities detected by preoperative laboratory tests were not actually noted or investigated before surgery.[5] This fact suggests that ordering routine tests does not provide legal protection, but quite possibly it also sets up an opportunity for increased legal liability. This relatively universal use of "routine" preoperative tests has not proven to be beneficial in terms of good patient care and, additionally, it has added significantly to the cost of medical care.[5,6] Focal and selective preoperative testing is more useful than routine "shotgun" testing. Seldom do all patients need all laboratory tests. Laboratory tests should be selected based on the individual patient's history and examination.

Key to the understanding of appropriate testing is an understanding of the risk category of the patient and the degree of the complexity of the planned surgery.

The risk category of any gynecological patient may be divided into one of the different classes as established by the American Society of Anesthesiologists (Table 6.1).

The degree of complexity of the planned surgery is divided into three separate types (Table 6.2).

Therefore, preoperative testing should be planned around the assessed risk of patient based on her age, history and physical examination, and the degree of

Table 6.1: Classification of physical status, established by the American Society of Anesthesiologists[7]

Class	*Description*
P1	A normal healthy patient
P2	A patient with mild systemic disease
P3	A patient with severe systemic disease
P4	A patient with severe systemic disease that is a constant threat to life
P5	A moribund patient who is not expected to survive without operation
P6	A declared brain dead patient whose organs are being removed for donor purposes

Table 6.2: Types of surgical procedures for which anesthesia may be administered[2]

Type	*General definition*
Type A	Minimally invasive procedures that have little potential to disrupt normal physiology and are associated with only rare periprocedural morbidity related to anesthesia. These procedures rarely require blood administration, invasive monitoring, and/or postoperative management in critical care settings.
Type B	Moderately invasive procedures that have a modest or intermediate potential to disrupt normal physiology. These procedures may require blood administration, invasive monitoring or postoperative management in a critical case setting.
Type C	Highly invasive procedures that typically produce significant disruption of normal physiology. These procedures commonly require blood administration or post operative management in a critical care setting.

complexity based on the invasiveness of the proposed surgery.

In asymptomatic and healthy patients, power of preoperative tests to predict adverse postoperative outcomes has been found to be either weak or non-existent.[5] Conclusions, such as this, have resulted in marked reduction in the routine testing and also the suggestion that the amount of routine testing of the preoperative asymptomatic healthy patients be related to the patient's age. In this category of patients it has been recommended that a hemoglobin or hematocrit be accomplished in all patients over the age of 6 months; an electrocardiograph on all patients over the age of 40 years; and a blood urea nitrogen test and a glucose test in all patients over the age of 65 years. Additionally, a pregnancy test should be accomplished in all reproductive age women who are at risk of early pregnancy (Table 6.3).

Women considered for gynecological surgery who are symptomatic and/or have other medical or surgical pathologies or defects must be considered in a different light from asymptomatic, healthy women during their preoperative evaluation and testing. Preoperative testing in these women should be done to determine the current

Table 6.3: Recommended preoperative testing for healthy asymptomatic gynecologic patient[2]

Age above 6 months	*Age above 40 years*	*Age above 65 years*
Hct or Hb	Hct or Hb ECG	Hct or Hb ECG BUN/Glucose

Abbreviations: Hct-Hematocrit; Hb-Hemoglobin; ECG-Electrocardiograph; BUN-Blood urea nitrogen.

status of medical or surgical pathologies and provide data on the potential effect that the compounding problem will have on the outcome of the proposed surgery. This would allow, if possible, for necessary medical correction or improvement of the problem prior to the surgery in an attempt to minimize adverse outcomes of surgical interventions. Fischer proposed preoperative testing evaluation considering both clinical outcomes as well as cost effectiveness. It is most appropriate in the preoperative evaluation of the gynecological patients who are other than healthy and asymptomatic (Table 6.4).

Preoperative Preparation

Preoperative care also includes any medical or gynecological management in the months preceding the surgical procedure to help achieve maximum physical status. Achieving this goal is rewarded by a less complicated surgical procedure with better outcomes. Examples of this include a number of options. Ovarian suppression through the use of a GnRH agonist in the 3 months before surgery has proven to be beneficial in hysteroscopic resection of uterine submucous leiomyomas > 2 cm in size and in myomectomies when the uterine volume is equal to or larger than 12 weeks pregnant uterus size. A similar suppression is also useful before endometrial ablation. Use of preoperative vaginal estrogen cream for 4-6 weeks before surgery may help in controlling uropathogens as well as thickening the vaginal mucosa which results in an easier dissection of vagina and in reducing postoperative morbidity.

Another area of preoperative planning requires an experienced decision by the gynecologist and anesthesiologist is the regulation of medications taken by the

Table 6.4: Diagnosis based preoperative testing[1]

Preoperative test	*Medical condition*
ECG	Cardiac dis, Chronic obstructive pulmonary dis, Central nervous system disorder, Thyroid dis, Parathyroid dis, Morbid obesity, Poor nutrition, Digoxin therapy
X-ray chest	Consider in congestive heart failure, Hypertension, Valvular heart disease, Chronic obstructive pulmonary disease, Morbid obesity
Complete blood counts	Chronic bronchitis, Hematological disorders, Coagulopathies, CNS disorders (stroke, seizures, tumor), Malignancy, Cushing's syndrome, Addison's disease, Poor nutrition, Steroids, Chemotherapy
Electrolytes	Hypertension (on diuretics), Diabetes, Heart disease, Renal disease, Stroke, Seizures, Thyroid disease, Cushing's disease, Addison's disease, Hyperparathyroidism, Poor nutrition, Diuretics use, Digoxin therapy
Renal profile	Hypertension, Diabetes, Renal disease, Poor nutrition, Diuretics
Glucose	Diabetes, Stroke, Seizures, Cushing's disease, Addison's disease, Marked obesity, Poor nutrition, Steroid therapy
Coagulation profile	Hepatic disease, Coagulopathies, Anticoagulant therapy, Poor nutrition
Liver function test	Liver disease
Calcium levels	Hyperthyroid, Parathyroid disease

patients prior to the surgery. Modification of insulin in the diabetic women, surgery on women taking anticoagulants, continuation/discontinuation of oral contraceptive pills are some of the issues that need to be addressed in the preoperative period.

It has been the practice to discontinue oral contraceptive pills 2-4 weeks before surgery because of the studies suggesting relationship between use of preoperative oral pills and postoperative venous thrombosis. This practice, however, is unsupported by current prospective controlled studies and places the patients at risk for unwanted pregnancy as well as menstrual irregularities. Therefore, routine discontinuation of oral combined contraceptive pills prior to gynecological surgery is not recommended but instead mechanical venous support such as elastic stockings or intermittent pneumatic compression be used at the time of surgery.

Antibiotic Prophylaxis

Postoperative infections remain a major source of morbidity and a less frequent cause of mortality in surgical patients. All major gynecological surgeries, either vaginal or abdominal carry a significant risk of infectious morbidity (20%).[8] Infections after hysterectomy include operative site infections, vaginal cuff cellulitis, pelvic cellulitis and pelvic abscess. Postoperative cuff cellulitis occurs in as many as 30-50% of premenopausal hysterectomies. Risk factors for infection after hysterectomy include longer duration of surgery, young age, diabetes, obesity, peripheral vascular disease, coagulation disorder, anemia, and poor nutritional state, past h/o surgical infection, presence of malignancy, prior radiotherapy and presence of indwelling catheters.

Operative-site infections after a hysterectomy result from the ascending spread of micro-organisms from the upper vagina and endocervix to the vaginal cuff and paravaginal tissues dissected during the procedure. Bacterial vaginosis, a complex alteration of vaginal flora resulting in an increased concentration of potentially pathogenic anaerobic bacteria, is associated with an increased risk of posthysterectomy cuff cellulitis.[9] However, there is a lack of data showing that pretreatment for bacterial vaginosis before hysterectomy reduces the rate of postoperative cuff cellulitis. These microorganisms can also spread to the abdominal incision at the time of surgery; in addition, the skin microorganisms *Staphylococcus epidermidis* and *Staphylococcus aureus* may lead to an abdominal incision infection. Gynecologic surgical procedures, such as laparotomy or laparoscopy, do not breach surfaces colonized with bacteria from the vagina, and infections following these procedures more commonly result from contaminating skin bacteria only. Procedures breaching the endocervix, such as hysterosalpingogram, sonohysterography, intrauterine device (IUD) insertion, endometrial biopsy, and dilation and curettage, may seed the endometrium and the fallopian tubes with microorganisms found in the upper vagina and endocervix.

The most critical factors in the prevention of postoperative infections, although difficult to quantify, are

the sound judgment and proper technique of the surgeon and the surgical team, as well as the general health and disease state of the patient. Antibiotic prophylaxis is increasingly used to augment host defense mechanism and prevent surgical infections.

Theory of Antimicrobial Prophylaxis

State-of-the-art aseptic technique has been associated with a dramatic decrease in operative-site infections but bacterial contamination of the operative site is inevitable. The *in vivo* interaction between the inoculated bacteria and prophylactically administered antibiotic is one of the most important determinants of the state of the surgical site. Systemic antibiotic prophylaxis is based on the belief that antibiotics in the host tissues can augment natural immune-defense mechanisms and help to kill bacteria that are inoculated into the wound. Only a narrow window of antimicrobial efficacy is available, requiring the administration of antibiotics either shortly before or at the time of bacterial inoculation (e.g., when the incision is made, viscus entered, or pedicles clamped). A delay of only 3-4 hours can result in ineffective prophylaxis.[10] The induction of anesthesia represents a convenient time for initiating antibiotic prophylaxis in major gynecologic procedures. Current data indicate that for lengthy procedures, additional, intraoperative doses of an antibiotic, given at intervals of one or two times the half-life of the drug, maintain adequate levels throughout the operation.[11] A second dose of the prophylactic antibiotic also may be appropriate in surgical cases with an increased blood loss (>1,500 ml). Neither subsequent doses nor treatment for several days before a procedure is indicated for prophylaxis. The use of prophylaxis implies that the patient is presumed to be free of infection at the time of the procedure. During a procedure when a patient is found to be at greater risk for disease, use of therapeutic antibiotics should be considered.

The cephalosporins have emerged as the drugs of choice for the vast majority of operative procedures because of their broad antimicrobial spectrum and low incidence of allergy and side effects. Cefazolin (1 gm) is the most commonly used agent because of its reasonably long half-life (1.8 hours) and low cost. It is the frequent choice for clean procedures, and most clinical studies indicate that it is equivalent to cephalosporins which have improved *in vitro* activity against anaerobic bacteria in clean-contaminated procedures such as hysterectomy.

Table 6.5: Antimicrobial prophylactic regimens by procedure[12]

Procedure	*Antibiotic*	*Dose*
Vaginal/Abdominal hysterectomy*	Cefazolin	1 or 2 gm single dose IV
	Cefoxitin	2 gm single dose IV
	Cefotetan	1 or 2 gm single dose IV
	Metronidazole	500 mg single dose IV
Laparoscopy	None	
Laparotomy	None	
Hysteroscopy	None	
Hysterosalpingogram	Doxycycline**	100 mg twice daily for 5 days orally
IUD insertion	None	
Endometrial biopsy	None	
Induced abortion/ D and C	Doxycycline	100 mg orally 1 hour before procedure and 200 mg orally after the procedure
	Metronidazole	500 mg twice daily orally for 5 days
Urodynamics	None	

Abbreviations: IV-intravenously; IUD-intrauterine device; D and C-dilation and curettage.
*A convenient time to administer antibiotic prophylaxis is just before induction of anesthesia.
**If hysterosalpingogram demonstrates dilated tubes, no prophylaxis is indicated for a normal study.

It should be readministered if the operation takes > 3 hours. Table 6.5 lists antibiotic regimens by procedure.

Antibiotics have been shown to reduce infectious complications in patients undergoing hysterectomy and surgical abortion by 50%.[8] There are also good data to support prophylactic antibiotics from a cost effectiveness perspective in these procedures. There has not been a demonstrated benefit for antibiotic use in patients undergoing laparoscopy without hysterectomy, exploratory laparotomy without vaginal entry or bowel surgery, hysteroscopy, intrauterine device insertion, endometrial biopsy or sonohysterography. Patients who have specific cardiac conditions that place them at increased risk for bacterial endocarditis also benefit from antibiotic prophylaxis.[12]

The risk of postoperative respiratory infection can be reduced by optimization of lung functions by medication and physiotherapy, cessation of smoking and early mobilization with good pain control. Attention to the indications for the use and duration of indwelling

catheters may influence the frequency of urinary tract infections.

Adjunctive Techniques to Prevent Postoperative Infections

Preoperative shaving of pubic and abdominal hair prior to gynecological surgery is generally not recommended; in fact preoperative shaving is associated with a significantly higher surgical site infection rate, particularly when completed the night before surgery. When hair removal is required, hair clipping is recommended at the time of surgery.[13]

Vaginal douching the night before surgery has been shown to be less effective than thorough cleansing of vagina with a povidone iodine solution immediately prior to surgery in the operation theatre.[14] Pelvic cleansing should be accomplished before all pelvic and abdominal surgeries. There is always the possibility that findings at the time of surgery may make a total abdominal hysterectomy advisable, even when preoperative plan did not include such an extensive procedure.

A shower with antiseptic soap in the evening before surgery remains a helpful adjunct to infection prevention.[14]

Abdomen is prepared with a 5 minutes scrub using a povidone iodine or similar solution. Particular attention should be paid to cleansing the umbilicus with a Q tip/ cotton swab applicator. The surgically prepared area should extend from inferior rib cage to mid thigh, laterally to anterior iliac crest and anterior axillary line. The actual skin washing and preparation should be accomplished using concentric circular moving towards the periphery.

Table 6.6: Hospital Infection Control Practices Advisory Committee (HICPAC) partial recommendations for the prevention of surgical site Infection-1999[13]

Rankings	
Category 1A	Strongly recommended for implementation and supported by well-designed experimental, clinical or epidemiologic studies
Category 1B	Strongly recommended for implementation and supported by some experimental, clinical or epidemiologic studies and strong theoretical rationale
Category II	Suggested for implementation and supported by suggestive clinical or epidemiologic studies or theoretical rationale
No recommendation; unresolved issue	Practices for which insufficient evidence or no consensus regarding efficacy exists
Recommendations-Preoperative—partial and modified	
A. Preparation of the patient	
Category 1A	Treat remote infection before elective operation; postpone surgery until treated. Do not remove hair from operative site unless necessary to facilitate surgery. If hair is removed, do immediately before surgery, preferably with electric clippers
Category 1B	Control serum blood glucose perioperatively. Cessation of tobacco use 30 days before surgery. Do not withhold necessary blood products to prevent SSIs. Shower or bath on night before operative procedure. Wash incision site before performing antiseptic skin preparation
Category II	Prepare skin in concentric circles from incision site. Keep preoperative stay in hospital as short as possible
Unresolved	Improve nutritional status, Use of mupirocin in nares, Improve oxygenation of wound space, Taper or discontinue systemic steroid use before elective surgery
B. Antimicrobial prophylaxis	
Category 1A	Select (if indicated) an antimicrobial agent with efficacy against expected pathogen. Intravenous route is used to ascertain adequate serum levels during operation and for at most a few hours after incision closed. Before elective colorectal operations, in addition to parenteral agent, mechanically prepare the colon by use of enemas and cathartics. Administer nonabsorbable oral antimicrobial agents in divided doses on the day before the operation
Category 1B	Do not routinely use vancomycin for antimicrobial prophylaxis

SSI = Surgical site infections

In 1999, the CDC's Health Care Infection Control Practice Advisory Committee published guidelines for prevention of infection (Table 6.6). These guidelines delve extensively into the literature concerning perioperative factors associated with postoperative infections. The above mentioned recommendations are based on these guidelines.

Bowel Preparation

Most gynecological procedures do not require a rigorous bowel preparation unless bowel surgery is expected. However, it is useful in pelvic surgery to try to ensure that a loaded colon does not limit access. A disposable enema or two suppositories given the night before surgery help to avoid this in most patients. But patients who have a history of adhesive disease, multiple previous surgeries, h/o intra-abdominal infection, severe endometriosis, h/o malignancy or a h/o peritoneal dialysis are at risk for bowel injury during surgery. In these patients mechanical bowel preparation with or without oral antibiotics has been shown to reduce the infectious complications associated with bowel injury. Mechanical bowel preparation also makes postoperative recovery more comfortable because of reduction of bowel gas. This may also reduce the volume of the bowels, making visualization easier during laparoscopy or laparotomy. Bowel preparation consists of 2 phases: mechanical cleansing and antibiotic administration. The postoperative infection rate can be reduced to well below 10% when these are properly performed.

Mechanical cleansing reduces the bulk of stool content within the lumen of the bowel, which also decreases the absolute amount of bacteria.[15] Anaerobes are the predominant flora in the colon, with an estimated density of 10^{10} organisms per gram of stool. Perforation and spillage of colon contents contaminates the peritoneal cavity with more than 400 species of bacteria. In the past, stool bulk was reduced via a low-residue or liquid diet combined with cathartics, enemas, or other agents given over 2 to 3 days. This regimen was time-consuming, patient compliance was poor, and nutritional intake was severely restricted prior to major surgery. Today, polyethylene glycol and sodium phosphate are the 2 most popular methods of bowel preparation.

1. **Polyethylene glycol** is a balanced electrolyte solution dispensed in a 4-L quantity that must be taken over 4 hours. Some patients find this volume difficult to consume; one option is administering the solution via a small nasogastric tube. Complications may include nausea/vomiting, abdominal cramping, and, rarely, fluid overload and electrolyte disturbances.
2. **Sodium phosphate** is administered in two 45 ml increments several hours apart. There is no consensus on which bowel-prep method is superior;[16] most surgeons prefer one or the other. Due to potential electrolyte abnormalities with the use of sodium phosphate, polyethylene glycol is favored for patients with significant renal, cardiac, or hepatic disease.

Antibiotics decrease bacterial concentration within the bowel lumen and are thought to reduce contamination and the likelihood of intra-abdominal abscess and wound infections. Minimally absorbed oral antibiotics like neomycin 1 gm orally and erythromycin 1 gm orally are given 3-4 times the day before surgery. Routine antibiotic prophylaxis with cephalosporins should be used in conjunction with mechanical and antibiotic bowel preparation.

Thromboembolism Prophylaxis

Most gynecological surgery is associated with a moderate risk of thromboembolism: 10-40% risk of thrombosis and 0.1-1% risk of fatal pulmonary embolism. In major pelvic surgery this rises to 40-80% risk of thrombosis and a 1-10% risk of fatal pulmonary embolism. This risk increases with age, obesity, malignancy and the complexity and duration of the procedure. All patients should be individually assessed for risk of thromboembolism and treated appropriately (Table 6.7). Low risk patients who are undergoing gynecologic surgery do not require specific prophylaxis other than early ambulation. Moderate and high risk gynecologic surgery candidates should be offered thromboprophylaxis.[17]
Recommendations alternative methods for thromboprophylaxis for these patients are:

Alternatives for thromboprophylaxis for moderate-risk patients undergoing gynecologic surgery include the following:

1. Thigh-high graduated compression stockings placed intraoperatively and continued until the patient is fully ambulatory.
2. Pneumatic compression placed intraoperatively and continued until the patient is fully ambulatory.
3. Unfractionated heparin (5,000 U) administered 2 hours before surgery and continued postoperatively every 8 hours until discharge.
4. Low-molecular-weight heparin (dalteparin, 2,500 antifactor-Xa U, or enoxaparin, 40 mg) administered 12 hours before surgery and once a day postoperatively until discharge.

Table 6.7: Classification of risk for thromboembolism in patients for gynecologic surgery

Risk category	*Patient and surgery characteristics*
Low risk group	Minor surgery (< 30 min), no risk factor other than age. Major surgery (> 30 min). Age < 40 yr, no other risk factor. Minor trauma or surgical illness
Moderate risk group	Major surgery, age ≥ 40 yr or other risk factors. Major medical illness; heart or lung disease, cancer, Inflammatory Bowel disease. Minor surgery, trauma, illness in patients with previous thromboembolism or thrombophilia
High risk group	Major pelvic or abdominal surgery for cancers. Major surgery, trauma, illness in patients with previous thromboembolism or thrombophilia, Lower limb paralysis

Risk category	*Incidence of venous thromboembolism*		
	Deep vein thrombosis	Proximal vein thrombosis	Fatal pulmonary embolism
Low risk group	< 10%	< 1%	< 0.01%
Moderate risk group	10-40%	1-10%	0.1-5%
High risk group	40-80%	10-30%	1-10%

Alternatives for prophylaxis for high-risk patients undergoing gynecologic surgery, especially for malignancy, include:

1. Pneumatic compression placed intraoperatively and continued until the patient is fully ambulatory.
2. Unfractionated heparin (5,000 U) administered 8 hours before surgery and continued postoperatively until discharge.
3. Dalteparin (5,000 antifactor-Xa U) administered 12 hours before surgery and then once a day thereafter.
4. Enoxaparin (40 mg) administered 12 hours before surgery and then once a day thereafter.

Evidence suggests that unfractionated heparin and low molecular weight heparin are equally effective in preventing venous thrombosis.[18]

CONCLUSIONS

Proper preoperative evaluation and planning for appropriate surgery as well as indicated and appropriate use of prophylactic measures to prevent surgical complications like sepsis and thromboembolism go a long way to achieve the successful outcome of gynecological surgery procedures. Preoperative care is as important as intraoperative management and postoperative care and should not be neglected.

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7 Thromboprophylaxis for Vaginal Surgery

Neerja Goel, Gunjan Singh

INTRODUCTION

There have been several studies in literature evaluating the benefits and risks of pharmacologic and physical agents used to prevent venous thromboembolism. Despite the convincing evidence of the efficacy of many agents, surveys conducted across the world document wide practice variations among surgeons; approximately one half of surgeons in these surveys use specific prophylaxis in less than one fifth of their patients. Skepticism of prophylaxis has partly been engendered by perceived variations in the actual risk of postoperative venous thromboembolism, fear of undesirable side effects (mainly bleeding), and concerns about costs. Much of the reluctance of surgeons to use prophylaxis, however, stems from the confusing and contradictory results of multiple clinical trials. Bewilderment is also compounded by the large number of prophylactic methods advocated and variations in end points used to judge efficacy and side effects.

Risk factors for venous thromboembolism include:

Patient Factors

1. Age
2. Obesity
3. Varicose veins
4. Immobility (bed rest over 4 days)
5. Pregnancy
6. Puerperium
7. High dose estrogen therapy
8. Previous deep vein thrombosis or pulmonary embolism
9. Thrombophilia.

Co-existing disease conditions

1. Malignancy
2. Recent myocardial infarction
3. Paralysis of lower limb(s)
4. Infection
5. Inflammatory bowel disease
6. Polycythemia
7. Nephritic syndrome
8. Paraproteinemia
9. Paroxysmal nocturnal hemoglobinuria
10. Behchet's disease
11. Homocystinemia.

Recommendations for Thromboprophylaxis

The Seventh American College of Chest Physicians Conference has recently updated comprehensive recommendations on antithrombotic therapy based on the current reports in literature.[1]

They have defined recommendations based on the supporting evidence as follows:

Grade 1 recommendations: Clear benefit.

Grade 2 recommendations: Unclear benefit.

These recommnedations are further subdivided into A, B, C and C+

- **A**: Based on Randomised Controlled Trials (RCTs) without important limitations and can apply to most patients in most circumstances without reservation.
- **B**: Based on RCTs with important limitations (inconsistent results, methodological flaws) but still likely to apply to most patients.
- **C**: Based on observational studies, and may change when stronger evidence is available.
- **C+**: No RCTs, but strong RCT results can be unequivocally extrapolated, or overwhelming evidence from observational studies can apply to most patients in most circumstances.

General Recommendations

1. For each of the antithrombotic agents, it has been recommended that manufacturer's suggested dosing guidelines should be followed (**Grade 1C**).
2. Aspirin **alone** should **NOT** be used as prophylaxis against venous thromboembolism for any patient group (**Grade 1A**).
3. Mechanical methods of prophylaxis be used primarily in patients who are at high risk of bleeding (**Grade 1C+**) or as an adjunct to anticoagulant-based prophylaxis (**Grade 2A**).
4. Attention should be directed towards ensuring the proper use of, and optimal compliance with, the mechanical device (**Grade 1C+**).
5. Renal impairment should be ruled out and when deciding on doses of **low-molecular-weight heparin (LMWH)**, the direct thrombin inhibitors, and other antithrombotic drugs that are cleared by the kidneys, particularly in elderly , corresponding adjustments should be made (**Grade 1C+**).
6. In all patients undergoing neuraxial anesthesia or analgesia, when using anticoagulant prophylaxis, care should be taken (**Grade 1C+**).

Specific Considerations during Gynecologic Surgery

1. Thromboprophylaxis should be used in all major gynecologic surgery patients (**Grade 1A**).
2. Brief procedures of ≤ 30 minutes for benign disease, early and persistent mobilization is better than any pharmacological intervention (**Grade 1C+**).
3. For patients undergoing laparoscopic gynecologic procedures, in whom additional venous thromboembolism risk factors are present, use of thromboprophylaxis with one or more of the following: Low Dose Unfractionated Heparin (LDUH), Low Molecular Weight Heparin (LMWH), IPC, or GCS should be done (all **Grade 1C**).
4. For patients undergoing major gynecologic surgery for benign disease, without additional risk factors, LDUH, 5,000 U bid (**Grade 1A**) is the first choice . Alternatives include once-daily prophylaxis with LMWH, ≤ 3, 400 U/d (**Grade 1C+**), or IPC started just before surgery and used continuously while the patient is not ambulating (**Grade 1B**).
5. For patients undergoing extensive surgery for malignancy, and for patients with additional venous thromboembolism risk factors, routine prophylaxis with LDUH, 5,000 U tid (**Grade 1A**), or higher doses of LMWH (i.e., > 3, 400 U/d) [**Grade 1A**] is recommended. Alternative considerations include IPC alone continued until hospital discharge (**Grade 1A**), or a combination of LDUH or LMWH plus mechanical prophylaxis with GCS or IPC (all **Grade 1C**).
6. For patients undergoing major gynecologic procedures, the prophylaxis should continue until discharge from the hospital (**Grade 1C**).
7. For patients who are at particularly high risk, including those who have undergone cancer surgery and are > 60 years of age or have previously experienced venous thromboembolism, continue prophylaxis for 2 to 4 weeks after hospital discharge (**Grade 2C**) (Fig. 7.1).

Additional Coexisting Medical Conditions

1. In patients who are confined to bed and have one or more additional risk factors, including malignancy, previous venous thromboembolism, sepsis, acute neurologic disease, or inflammatory bowel disease, prophylaxis with LDUH (**Grade 1A**) or LMWH (**Grade 1A**) is recommended.
2. In medical patients with risk factors for venous thromboembolism, and in whom there is a contraindication to anticoagulant prophylaxis, use of mechanical prophylaxis with GCS or IPC (**Grade 1C+**) should be done.

Additional considerations in cancer patients waiting for surgery or in post-surgical period:

1. It is recommended that cancer patients undergoing surgical procedures receive prophylaxis that is appropriate for their current risk state **(Grade 1A)**.
2. Do not routinely use prophylaxis to try to prevent thrombosis related to long-term indwelling central venous catheters (CVCs) in cancer patients **(Grade 2B)**. Specifically, it is suggested that one should not use LMWH **(Grade 2B)**, and it is recommended against the use of fixed-dose warfarin **(Grade 1B)** for this indication.

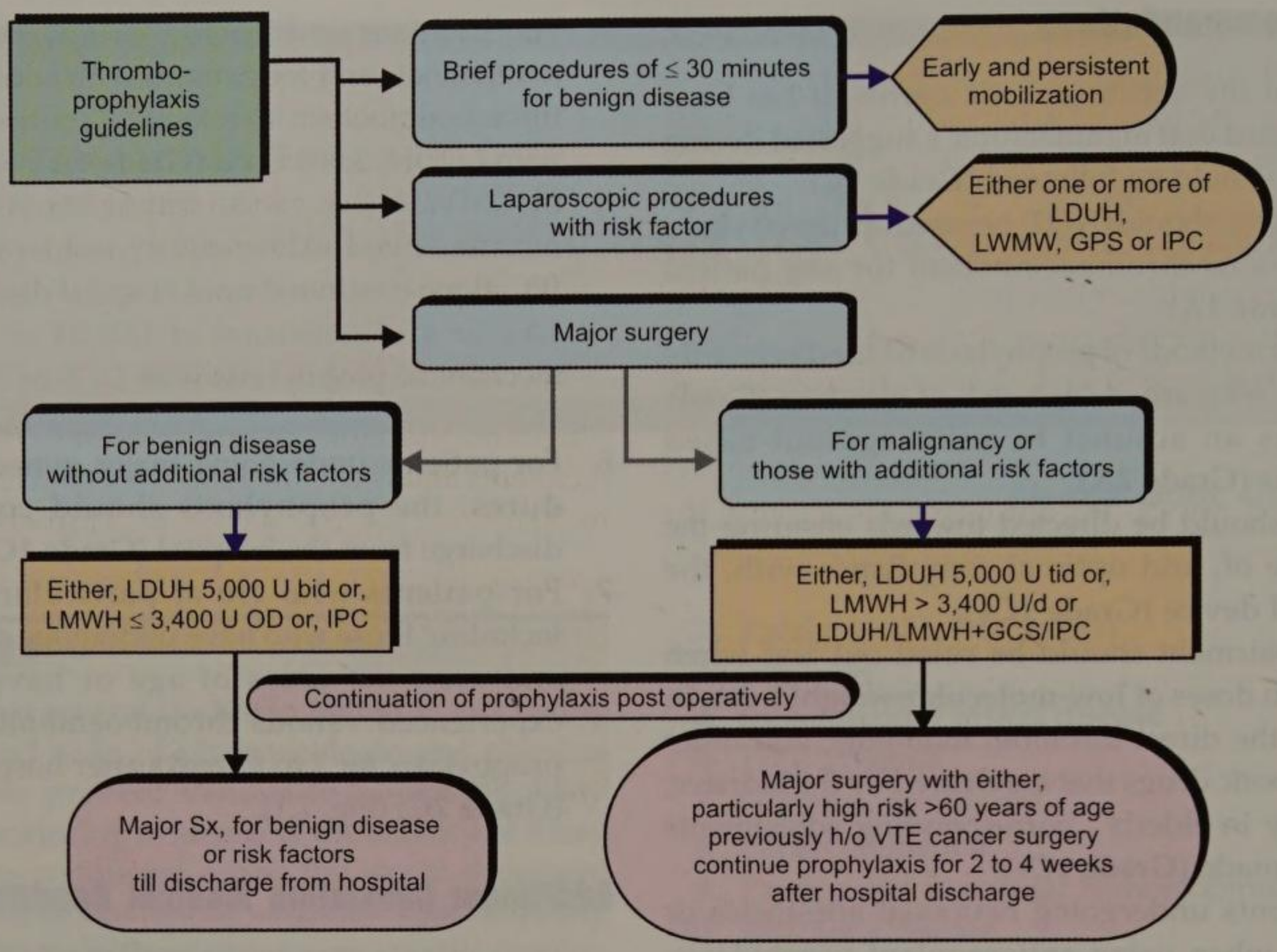
Thrombo-prophylaxis guidelines
Brief procedures of ≤ 30 minutes for benign disease
Early and persistent mobilization
Laparoscopic procedures with risk factor
Either one or more of LDUH, LWMW, GPS or IPC
Major surgery
For benign disease without additional risk factors
For malignancy or those with additional risk factors
Either, LDUH 5,000 U bid or, LMWH ≤ 3,400 U OD or, IPC
Either, LDUH 5,000 U tid or, LMWH > 3,400 U/d or LDUH/LMWH+GCS/IPC
Continuation of prophylaxis post operatively
Major Sx, for benign disease or risk factors till discharge from hospital
Major surgery with either, particularly high risk >60 years of age previously h/o VTE cancer surgery continue prophylaxis for 2 to 4 weeks after hospital discharge

Fig. 7.1: Thromboprophylaxis guidelines

Long Distance Travel after Surgery

1. General measures for long-distance travellers (i.e., flights of > 6 hours duration): avoidance of constrictive clothing around the lower extremities or waist, avoidance of dehydration, and frequent calf muscle stretching **(Grade 1C)**.
2. For long-distance travelers with additional risk factors for venous thromboembolism, the general strategies listed above are to be followed. If active prophylaxis is considered, because of the perceived increased risk of venous thrombosis, use of properly fitted, below-knee GCS providing 15 to 30 mmHg of pressure at the ankle **(Grade 2B)**, or a single prophylactic dose of LMWH injected prior to departure **(Grade 2B)** should suffice.
3. Aspirin use is not advocated for venous thromboembolism prevention associated with travel **(Grade 1B)**.

Drugs Used for Thromboprophylaxis

Heparin and its derivative, low-molecular-weight heparin (LMWH), are the anticoagulants of choice when a rapid anticoagulant effect is required. Their salient features are as follows:[2]

Unfractionated heparin: Heparin was discovered by McLean in 1916. The preferred route of Unfractionated heparin (UFH) administration is continuous IV infusion. It binds to AT-III and catalyzes inactivation of factors IIa, Xa, IXa, and XIIa: only one-third of heparin molecules, containing the unique AT-III-binding pentasaccharide, carry out this effect. It binds to heparin cofactor II and catalyzes inactivation of factor IIa: anticoagulant effect requires high concentrations of heparin and occurs to the same degree whether or not the heparin has high or low affinity for AT-III. Heparin clearance involves two pathways. First has rapidly saturable pharmacokinetics through binding to receptors on endothelial cells and macrophages where it is depolymerized. The second is much slower and follows first order elimination through kidney. At therapeutic doses, heparin is cleared predominantly through the rapid saturable, dose-dependent mechanism and its anticoagulant effects are nonlinear. This causes a disproportionate rise in intensity and duration of effect with increasing dose.

Low molecular weight heparin: LMWHs are derived from heparin by chemical or enzymatic depolymerization of heparin to one-third its original size. They differ to some extent in pharmacokinetic properties and anticoagulant profile, and may not be clinically interchangeable. Compared to UFH, LMWH have reduced antifactor IIa activity relative to antifactor Xa activity and lesser ability to inactivate thrombin because the smaller fragments cannot bind simultaneously to both antithrombin and thrombin.

However, since bridging between antithrombin and factor Xa is less critical for antifactor Xa activity, the smaller fragments inactivate factor Xa almost as well as do larger molecules.

LMWHs are cleared principally by the renal route, and their biological half-life is prolonged in patients with renal failure. LMWH preparations have a longer plasma half-life and better bioavailability at low doses than UFH, and a more predictable dose response. These findings provided the rationale for comparing unmonitored weight-adjusted LMWH with APTT-guided unfractionated heparin.

- Both types of heparins are administered in lower doses for primary prophylaxis than for treatment of venous thrombosis.
- Heparin therapy is usually restricted to the hospital setting, where its effect can be monitored and its dosage adjusted frequently. On the other hand, LMWH preparations can be administered in either in patient or out patient setting because they can be administered subcutaneously (sc) without the need for laboratory monitoring (Fig. 7.2 and Table 7.1).

Major Side Effects of Heparin

Thrombocytopenia occurs in about 10% of heparin recipients and is usually mild with platelet count falling to 50,000 to1,00,000/microlitre. Thrombocytopenia is

Fig. 7.2: Heparin and LMW heparin preparations

Table 7.1: Pharmacological preparations of LMW heparin available in India

Drug name	*Brand name*	*Company*	*Available as*	*Preparation*		*Price range*
Enoxaparin sodium	Clexane	Aventis Pharma	Injection in prefilled syringe (PFS)	20-80 mg	0.2, 0.4, 0.6, 0.8 ml	Rs 460-1102
Enoxaparin sodium	LMWX	Nicholas Piramal	Injection	20-80 mg	0.2-0.8 ml	Rs 230-546
Certoparin sodium	Troparin	Novartis	Injection	3000 iu	5 × 0.3 ml	Rs 1234
Dalteparin sodium	Fragmin	Pharmacia India	Ampoule, Injection in PFS, vial	2500-10,000 iu/ml	0.2-10 ml	Rs 226.18-3989
Dalteparin sodium	Fragmin GS	Pharmacia India	Injection in graduated syringe	7500-10000 iu	1 injection	Rs 449.89-523.98
Nadroparin	Fraxiparine	Sanofi Synthelabo	Injection in PFS	3075-8600 iu	0.3-0.8 ml	Rs 259.15-525.41
Nadroparin	Nadroparin	Bharat Serum & Vaccines	Vial	2850-5700 iu	1 vial	Rs 210-300
Reviparin sodium	Clivarine	Knoll Pharma	Injection in PFS	1432, 3436 iu	1 injection	Rs 225 and 350
Tinzaparin	Logiparin	Med-India	Injection in PFS, vial	3500 iu, 10,000 iu/ml	0.35 ml, 2 ml	Rs 200 and 995

more common in patients receiving heparin derived from beef lung as opposed to porcine lung-intestinal mucosa. Low molecular weight heparin is less likely to cause thrombocytopenia. Unfortunately, majority of antibodies arising from exposure to unfractionated heparin cross react, so low molecular weight heparins cannot usually be used to treat patients with established thrombocytopenia. Occasionally, thrombocytopenia can be severe and may be accompanied by intravascular platelet agglutination and arterial thrombosis. Recognition of the rare complication of thrombocytopenia and paradoxical thrombosis is critical, since discontinuing heparin may promptly reverse the syndrome and may be life saving. Heparin administration for longer than five months also carries a risk of osteoporosis, perhaps through the activation of osteoclasts.

Non-Pharmacological Measures for Thromboprophylaxis

Graduated compression stockings:[3,4] These are physical devices used to prevent thromboembolism. These stockings are worn from ankle to above knee. These stockings have special elastic threads, which are utilized to apply a precise amount of pressure to prescribed areas of the leg starting with maximum pressure at the ankles and progressive reduction in that pressure up the length of the stocking (Fig. 7.3).

They prevent venous stasis by forcing blood from superficial venous system into deep venous system, stimulating the venous pump to achieve proper blood flow to the heart. They have also been said to improve and regulate the flow of blood in the legs and back to the heart. It is used either as a preventive measure for deep vein thrombosis or to relieve chronic edema or spreading of varicose veins. These devices are freely available in the developed world, with prices starting from US $20 onwards.

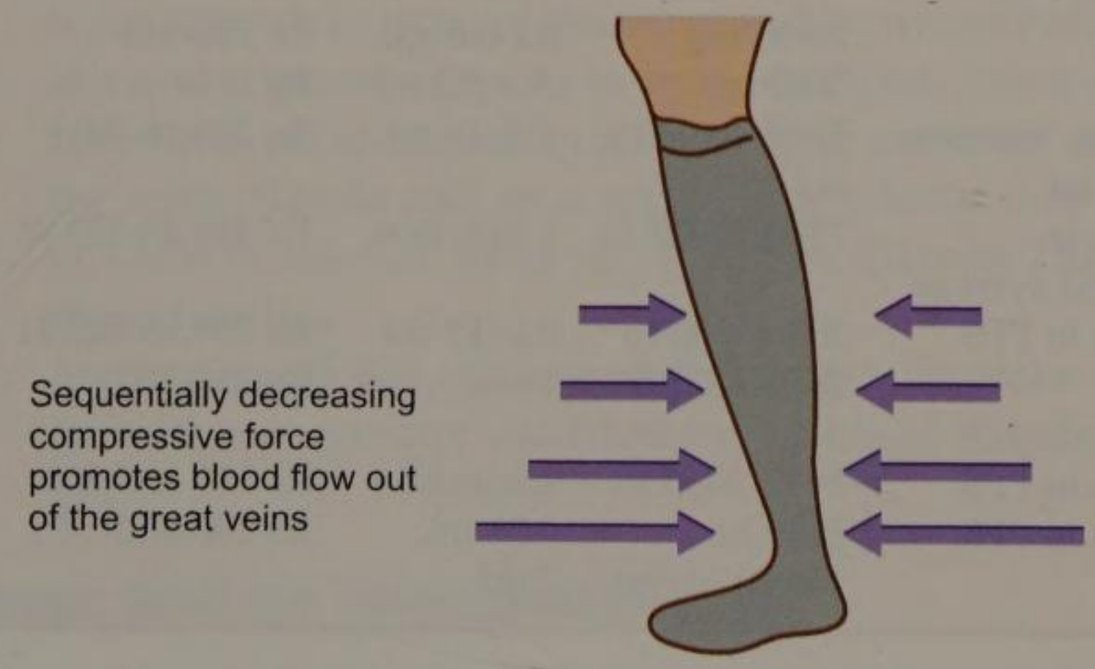

Fig. 7.3: Graduated compression stockings

The patient has to be taught how to wear them because the major complaint is that they are "too tight," which actually is a marker of efficacy. They have to be worn for a variable time depending on the pathology, generally during daytime.

There are contraindications to use of these stockings. They should not be used in uncontrolled congestive heart failure, septic phlebitis of the leg, phlegmasia cerulea dolens, skin infections, weeping dermatosis, incompatibility to fabric of garment and impaired sensitivity of the limb.

The advantage over intermittent pneumatic compression is that the patients remain ambulatory, can wear the stockings for prolonged period and there is less discomfort with stockings when compared with the pressure associated with intermittent leg compressions from pneumatic devices. In addition, the garments do not require assembly once fitted, are not subject to malfunction or troubleshooting, and facilitate patient mobility and ambulation during the postoperative recovery period.

Patient Instructions Regarding Wearing the GCS

Properly fitting graduated compression hosiery snugly fits especially in levels from 15-30 mm/Hg. Telling the patient that it will take few days to adjust to the pressure of support is comforting. Compression stockings are easier to put on before the patient gets out of bed and before swelling occurs.

Step-by-Step Method to put on the Stockings

1. The patient should lie on the bed and elevate her legs for a few minutes.
2. After which, she should sit up, keeping her legs on the bed.
3. Then she should take one piece of the stocking and fold it in between her hands completely.
4. The support stocking should be pulled over the foot preferably in one motion.
5. Same procedure should be repeated with the other leg.
6. The stockings should be unrolled slowly, little at a time. Alternating between the two legs saves time. Any folds and wrinkles should be smoothened out.

Additional Points to be taken Care of during Wearing GCS

1. Skin should be free of water when stockings are being put on. Apply a thin layer of talcum powder to help the stockings to slide over the skin.
2. Rolling, gathering or bunching the fabric should be avoided as it acts as a rubber band and increases the pressure.
3. No moisturizer or emollients should be applied on the legs just before applying the stockings, as it can dirty them.
4. To remove the stocking, the patient should gently peel it back like a banana and ease it over the heel with the palm.
5. The life of these stockings is dependent on the number of uses and washings, much like a crepe bandage, and therefore it should be kept clean and dry to achieve best results.

Intermittent Pneumatic Compression[3,6,7]

Pneumatic compression devices consist of an inflatable garment for the leg and an electrical pneumatic pump that fills the garment with compressed air (Fig. 7.4).

Modern devices evacuate blood from lower-extremity vessels in an automated fashion A microprocessor controlled device directs pressurized air into segmental diaphragms secured around the leg for a fixed period intermittently.

Therefore, the compression is delivered in a sequential manner up the leg, producing a wavelike milking effect to evacuate leg veins. The compression is set to cycle regularly for example, every 60 seconds. Devices are available for feet, calves, and/or thighs.

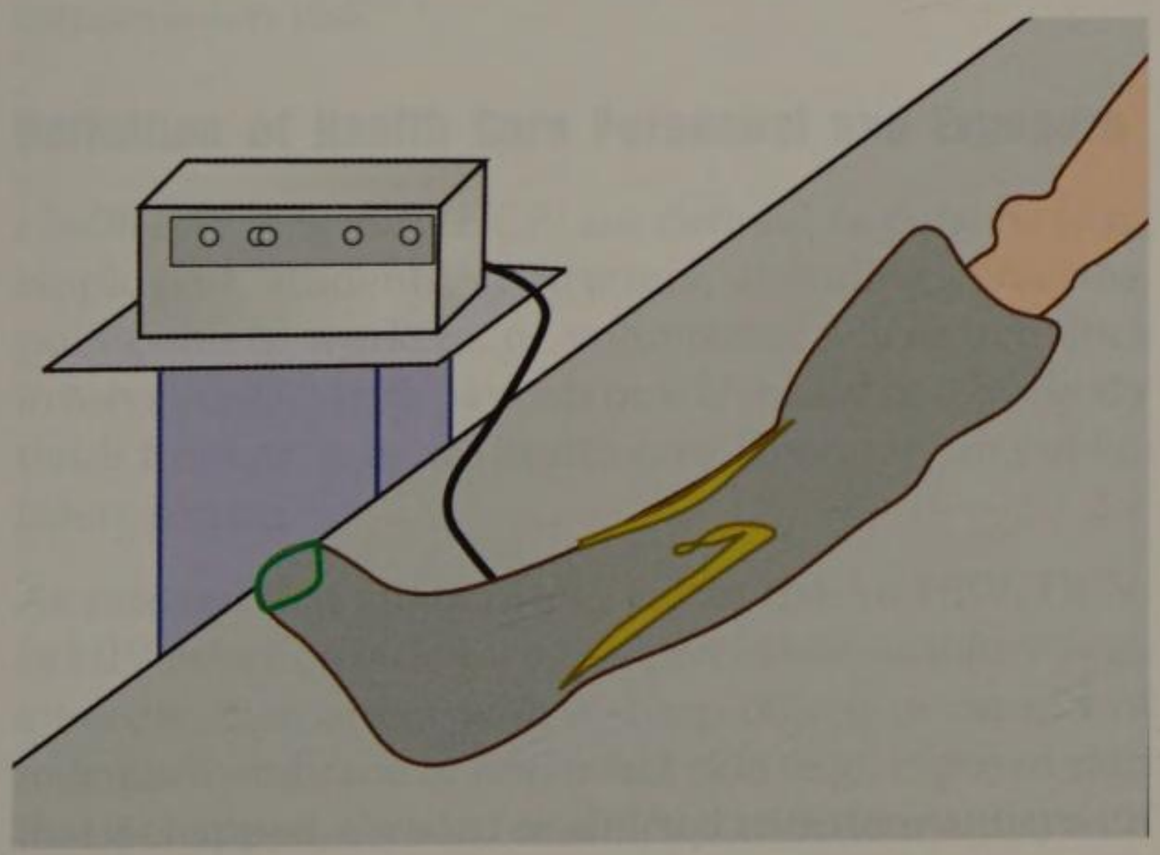

Fig. 7.4: Intermittent pneumatic compression device

The advantage over graduated compression stocking is that it is a more controlled and reliable method. In bedridden patients, these devices can be more effective than using stockings.

The disadvantages include high cost, machine dependence and lack of mobility.

Contraindications for the use of these devices include: dermatitis, postoperative vein ligation, gangrene, recent skin graft, severe ischemic vascular disease, severe lower extremity edema, extreme leg deformity, suspected pre-existing DVT. A recent meta-analysis found that IPC devices are effective in decreasing the incidence of DVT in patients at moderate to high risk and are probably more efficacious than graduated compression stockings or mini-dose heparin.[6]

CONCLUSIONS

All patients undergoing surgery can potentially develop thromboembolism. Therefore, a universal screening and practice pattern for thromboprophylaxis should be used in treatment protocols. The prefered pharmacological agents are low molecular weight heparin and unfractionated heparin, each having distinct advantages and disadvantages. Non-pharmacological devices like compression stockings and intermittent pneumatic compression devices have their own utility in prevention of thromboembolism.

Key Points

1. Thromboprophylaxis should be used in all major gynecologic surgery patients.
2. All patients may not be suitable for thromboprophylaxis and, therefore, they should be carefully assessed before a therapeutic or prophylactic regimen is started.
3. For brief procedures of ≤ 30 minutes for benign disease, early and persistent mobilization is better than any pharmacological intervention.
4. For any patient found to be a suitable candidate for thromboprophylaxis, the recommendations include either one or a combination from the following: low dose unfractionated heparin, low molecular weight heparin, intermittent pneumatic compression, or graduated compression stockings.
5. The prophylaxis should continue for 2 to 4 weeks after discharge from the hospital or otherwise indicated.

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8 Reducing Surgical Risk for HIV and Hepatitis B Infection

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INTRODUCTION

Avoiding occupational blood exposures is the primary way to prevent transmission of hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) in health-care settings.[1] Universal precautions should be taken to avoid transmission of HIV and HBV. However, hepatitis B immunization and post exposure management are integral components of a complete program to prevent infection following blood borne pathogen exposure and are important elements of workplace safety.[2] In addition, questions exist regarding considerations about PEP regimens when the source person's virus is known or suspected to be resistant to one or more of the antiretroviral agents that might be used for PEP. Concern also has arisen about the use of PEP when it is not warranted. Data indicate that some health-care personnel (HCP) take a full course of HIV PEP after exposures that do not confer an HIV transmission risk.[3, 4]

Definition of Health Care Personnel and Exposure

Health care personnel (HCP) are defined as persons (e.g., employees, students, contractors, attending clinicians, public-safety workers, or volunteers) whose activities involve contact with patients or with blood or other body fluids from patients in a health-care, laboratory, or public-safety setting.

An exposure that might place HCP at risk for HBV, HCV, or HIV infection is defined as a percutaneous injury (e.g., a needle stick or cut with a sharp object) or contact of mucous membrane or non intact skin (e.g., exposed skin that is chapped, abraded or afflicted with dermatitis) with blood, tissue, or other body fluids that are potentially infectious.[5,6] In addition to blood and body fluids containing visible blood, semen and vaginal secretions also are considered potentially infectious. Although semen and vaginal secretions have been implicated in the sexual transmission of HBV, HCV, and HIV, they have not been implicated in occupational transmission from patients to HCP. The following fluids also are considered potentially infectious: cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid. The risk for transmission of HBV, HCV, and HIV infection from these fluids is unknown; the potential risk to HCP from occupational exposures has not been assessed by epidemiologic studies in health-care settings. Faeces, nasal secretions, saliva, sputum, sweat, tears, urine, and vomitus are not considered potentially infectious unless they contain blood. The risk for transmission of HBV, HCV, and HIV infection from these fluids and materials is extremely low.

Any direct contact (i.e., contact without barrier protection) to concentrated virus in a research laboratory or production facility is considered an exposure that requires clinical evaluation.

Risk for Occupational Transmission

HBV

It depends on:

1. Degree of contact with blood.
2. HBe status of the source.

HIV

Although episodes of HIV transmission after nonintact skin exposure have been documented,[9] the average risk

Table 8.1: Percentage risk of HBV transmission

	HBs +ve and HBe +ve	*HBs +ve and HBe -ve*
Clinical hepatitis	22-31%	1-6%
Serological +ve	37-62%	23-37%

Table 8.2: Percentage risk of HIV transmission[7,8]

Type of exposure	*Average risk*	*95% CI range*
Percutaneous exposure	0.3%	0.2%–0.5%
Mucous membrane exposure	0.09%	0.006%–0.5%

for transmission by this route has not been precisely quantified but is estimated to be less than the risk for mucous membrane exposures (Tables 8.1 and 8.2).[10]

Factors affecting the risk of HIV transmission:

a. A device visibly contaminated with the patient's blood,
b. A procedure that involved a needle being placed directly in a vein or artery, or
c. A deep injury.[11]
d. Exposure to blood from source persons with terminal illness.

Although a lower viral load (e.g., < 1,500 RNA copies/mL) or one that is below the limits of detection probably indicates a lower titre exposure, it does not rule out the possibility of transmission.

Some evidence exists regarding host defenses possibly influencing the risk for HIV infection.[12] The host immune response sometimes might prevent establishment of HIV infection after a percutaneous exposure.

Precautions to Prevent Transmission of HIV and HBV

Universal Precautions

Since medical history and examination cannot reliably identify all patients infected with HIV or other blood-borne pathogens, blood and body-fluid precautions should be consistently used for ALL patients. This approach, previously recommended by CDC,[13] and referred to as "universal blood and body-fluid precautions" or "universal precautions," should be used in the care of ALL patients, especially including those in emergency-care settings in which the risk of blood exposure is increased and the infection status of the patient is usually unknown.[14]

1. All health care workers should routinely use appropriate barrier precautions to prevent skin and mucous-membrane exposure when contact with blood or other body fluids of any patient is anticipated. Gloves should be worn for touching blood and body fluids, mucous membranes, or non-intact skin of all patients, for handling items or surfaces soiled with blood or body fluids, and for performing venipuncture and other vascular access procedures. Gloves should be changed after contact with each patient.
2. Masks and protective eyewear (Fig. 8.1) or face shields should be worn during procedures that are likely to generate droplets of blood or other body fluids to prevent exposure of mucous membranes of the mouth, nose, and eyes.
3. Gowns or aprons (Figs 8.2 and 8.3) should be worn during procedures that are likely to generate splashes of blood or other body fluids.
4. Hands and other skin surfaces should be washed immediately and thoroughly if contaminated with blood or other body fluids. Hands should be washed immediately after gloves are removed.
5. All health-care workers should take precautions to prevent injuries caused by needles, scalpels, and other sharp instruments or devices during procedures; when cleaning used instruments; during disposal of used needles; and when handling sharp instruments after procedures.

Fig. 8.1: Protective eye wear

Fig. 8.2: Disposable gown

Fig. 8.3: Showing boots, gown and plastic apron

6. To prevent needle stick injuries, needles should not be recapped, purposely bent or broken by hand, removed from disposable syringes, or otherwise manipulated by hand. After they are used, disposable syringes and needles, scalpel blades, and other sharp items should be placed in puncture-resistant containers for disposal after being destroyed in needle destroyer; the puncture-resistant containers should be located as close as practical to the use area. Large-bore reusable needles should be placed in a puncture-resistant container for transport to the reprocessing area.
7. Although saliva has not been implicated in HIV transmission, to minimize the need for emergency mouth-to-mouth resuscitation, mouth- pieces, resuscitation bags, or other ventilation devices should be available for use in areas in which the need for resuscitation is predictable.
8. Health-care workers who have exudative lesions or weeping dermatitis should refrain from all direct patient care and from handling patient-care equipment until the condition resolves.
9. Pregnant health-care workers are not known to be at greater risk of contracting HIV infection than health-care workers who are not pregnant; however, if a health-care worker develops HIV infection during pregnancy, the infant is at risk of infection resulting from perinatal transmission. Because of this risk, pregnant health-care workers should be especially familiar with and strictly adhere to precautions to minimize the risk of HIV transmission. Implementation of universal blood and body-fluid precautions for ALL.
10. *Reduce unnecessary procedures:* Health care workers need to be trained to avoid unnecessary blood transfusions (e.g., using volume replacement solutions), injections (e.g., prescribing oral equivalents), suturing (e.g., episiotomies) and other invasive procedures. Standard treatment guidelines should include the use of oral medications whenever possible.

Precautions for Invasive Procedures

The universal blood and body-fluid precautions listed above, combined with the precautions listed below, should be the minimum precautions for ALL such invasive procedures.

1. All health-care workers who participate in invasive procedures must routinely use appropriate barrier precautions to prevent skin and mucous-membrane contact with blood and other body fluids of all patients.
2. Protective eyewear (Fig. 8.1) or face shields should be worn for procedures that commonly result in the generation of droplets, splashing of blood or other body fluids, or the generation of bone chips.
3. Gowns or aprons (Figs 8.2, 8.3 and 8.7) made of materials that provide an effective barrier should be worn during invasive procedures that are likely to result in the splashing of blood or other body fluids.

4. Boots (Figs 8.4 and 8.5) rather than open-toed shoes should be worn to protect the feet when something sharp is dropped or blood is spilled over the floor.
5. Double gloves (Fig. 8. 6) and surgical masks (Fig. 8.5) must be worn for all invasive procedures.
6. Skin contamination from glove perforation can be reduced approximately five folds by wearing two pairs of gloves. It is preferable that larger sized glove worn on inside and a half size, smaller glove is worn as the outer second layer.
7. If a glove is torn or a needle stick or other injury occurs, the glove should be removed, blood should be allowed to flow freely, and a new glove used as promptly as patient safety permits; the needle or instrument involved in the incident should also be removed from the sterile field.
8. Surgeons should always use instruments to hold a needle and other sharp instruments. One should never fiddle with hands, especially when operating in depth.
9. Nurse should always use kidney tray to deliver the sharp instruments like needle, scalpel.

Fig. 8.5: Surgeon wearing impermeable plastic apron, cap, surgical mask, protective goggles and boots before scrubbing

Special Precautions while Operating upon a known HIV +ve Patient

1. An impermeable plastic apron must be worn underneath the sterile gown to avoid seepage of blood through clothes.
2. Always wear gum boots rather than open bathroom slippers. The blood which spills on the floor also stains

Fig. 8.4: Protective footwear

Fig. 8.6: Surgeon wearing double gloves

feet and small cracks around the nails and on soles are very prone areas to get the HIV infection without the knowledge of the surgeon.
3. To avoid spillage of the blood and body fluids in nose, eyes and lips, one should always wear mask and protective eye wears or face shields.
4. A new IV Cannula is available in which an inner stillet with a guard opens automatically after it comes out from its outer sheath and the risk of needle prick

Fig. 8.7: Surgeon ready to operate after scrubbing

injury decreases. Another advantage is that it cannot be reused (Fig. 8.8).

5. Always wear double gloves, inner pair should be preferably a half size bigger than the outer one. This reduces the risk of needle stick injuries.
6. Only disposable linen should be used which can be disinfected and discarded after proper care (Sterilization details are mentioned later) (Fig. 8.9).
7. All the used instruments should be properly sterilized before reuse.
8. Operation theatre must be thoroughly cleaned with sodium hypochlorite solution.

Sterilization and Disinfection

1. Standard sterilization and disinfection procedures for patient-care equipment currently recommended for use[15] in a variety of health- care settings are adequate to sterilize or disinfect instruments, devices, or other items contaminated with blood or other body fluids from persons infected with blood-borne pathogens including HIV.[16]

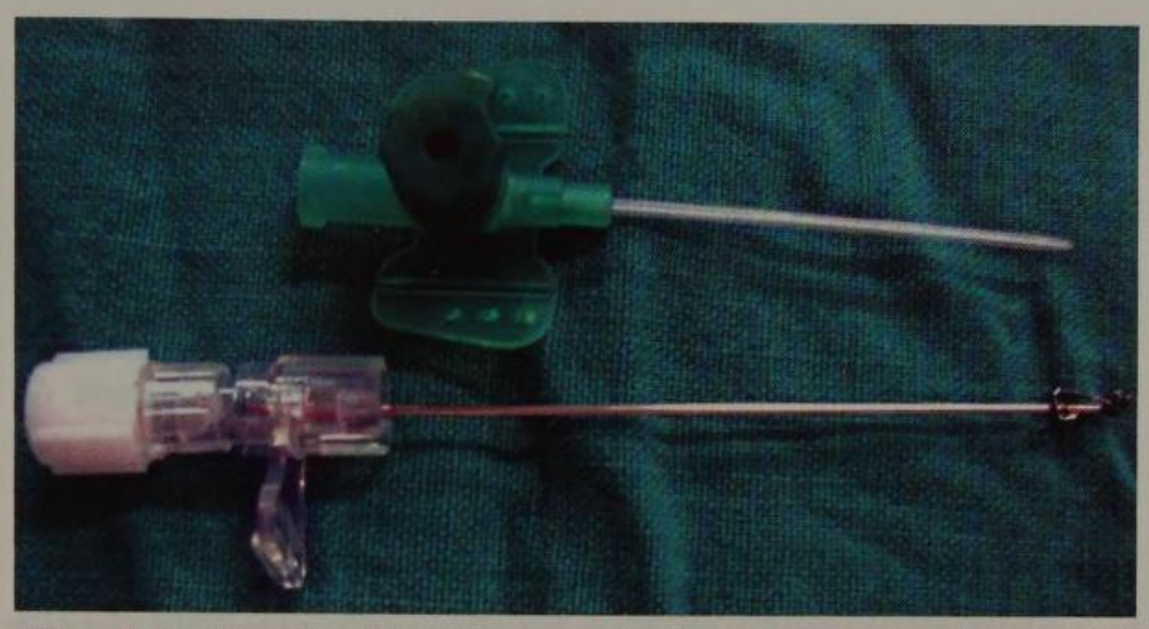

Fig. 8.8: IV cannula with a protective inner sheath should be used so as to avoid needle stick injury

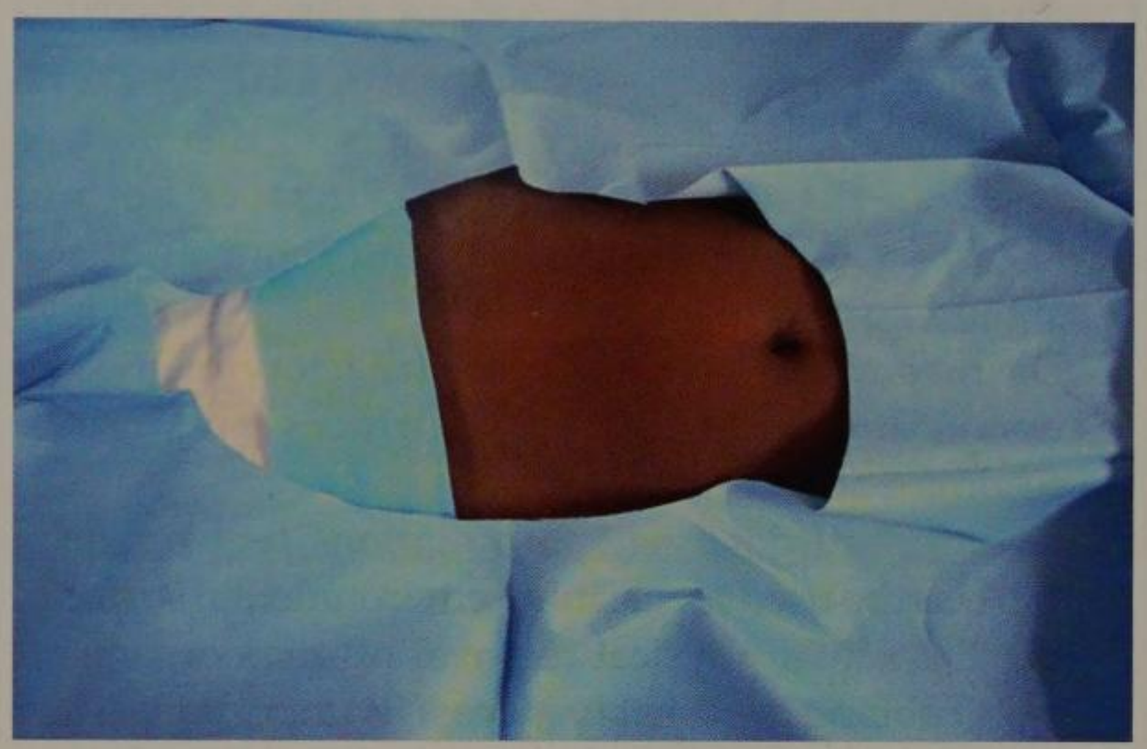

Fig. 8.9: All disposable linen should be used for a known HIV +ve patient

2. Instruments or devices that enter sterile tissue or the vascular system of any patient or through which blood flows should be sterilized before reuse. Devices or items that contact intact mucous membranes should be sterilized or receive high-level disinfection, a procedure that kills vegetative organisms and viruses but not necessarily large numbers of bacterial spores.
3. Medical devices or instruments that require sterilization or disinfection should be thoroughly cleaned before being exposed to the germicide and the manufacturer's instructions for the use of the germicide should be followed.
4. Studies have shown that HIV is inactivated rapidly after being exposed to commonly used chemical germicides at concentrations that are much lower than used in practice.[17] In addition to commercially

available chemical germicides, a solution of sodium hypochlorite (household bleach) (Fig. 8.10) prepared daily is an inexpensive and effective germicide. Concentrations ranging from approximately 500 ppm (1:100 dilution of household bleach) sodium hypochlorite to 5,000 ppm (1:10 dilution of household bleach) are effective depending on the amount of organic material (e.g., blood, mucus) present on the surface to be cleaned and disinfected. Commercially available chemical germicides may be more compatible with certain medical devices that might be corroded by repeated exposure to sodium hypochlorite, especially to the 1:10 dilution.

5. Environmental surfaces such as walls, floors, and other surfaces are not associated with transmission of infection to patients or health care workers. Therefore, extraordinary attempts to disinfect or sterilize these environmental surfaces are not necessary. However, cleaning and removal of soil should be done routinely.
6. Disinfectant fogging is an unsatisfactory method of decontaminating air and surfaces and is not recommended.
7. Disinfectant-detergent formulations registered by EPA can be used for cleaning environmental surfaces, but the actual physical removal of microorganisms by scrubbing is probably at least as important as any antimicrobial effect of the cleaning agent used.
8. Cleaning and decontaminating spills of blood or other body fluids with large spills of cultured or concentrated infectious agents in the laboratory, the contaminated area should be flooded with a liquid germicide before cleaning, and then decontaminated with fresh germicidal chemical. In both settings, gloves should be worn during the cleaning and decontaminating procedures.

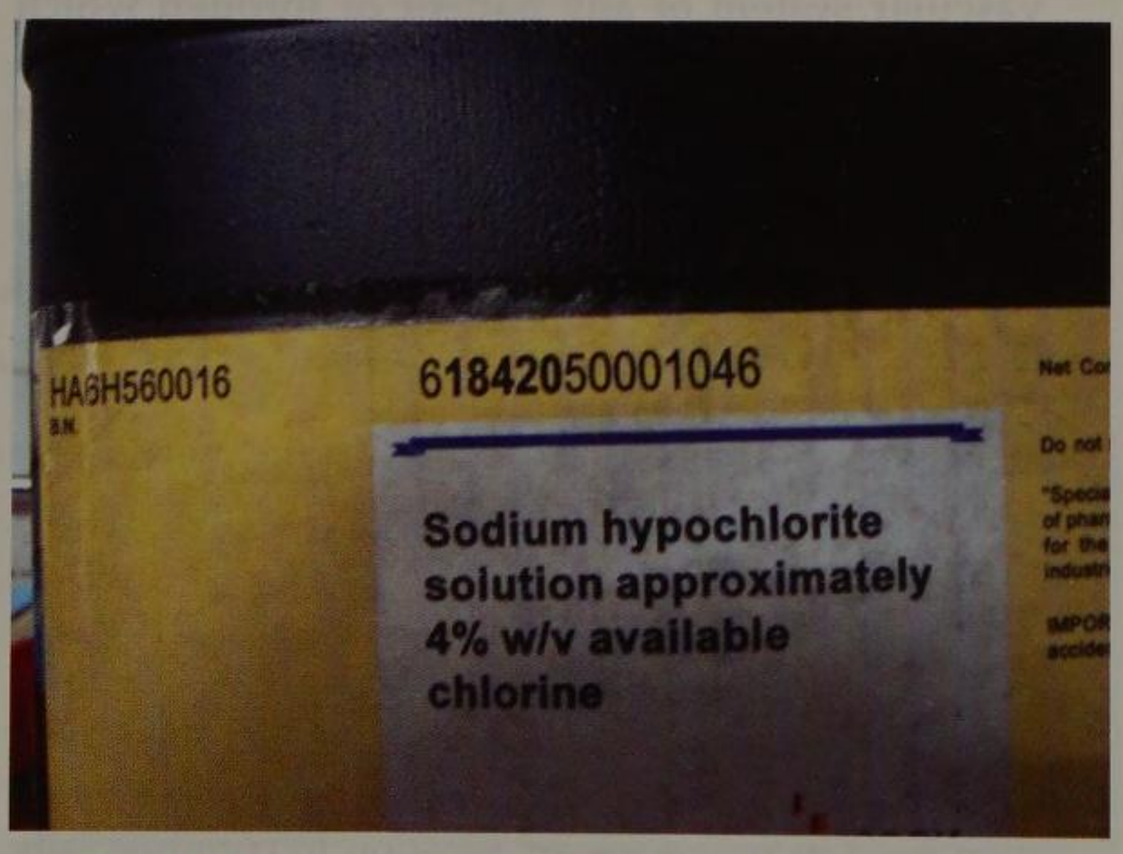

Fig. 8.10: All HIV contaminated surfaces should be cleaned with sodium hypochlorite solution

Management of Exposures

If a health care worker gets exposed to blood or body fluids despite universal precautions, then following steps should be taken.

Evaluation of the Exposure and the Exposure Source

Evaluation of the Exposure

Type of exposure

1. Percutaneous injury.
2. Mucous membrane exposure.
3. Nonintact skin exposure.
4. Bites resulting in blood exposure to either person involved.

Type and amount of fluid/tissue

1. Blood.
2. Fluids containing blood.
3. Potentially infectious fluid or tissue (semen; vaginal secretions; and cerebrospinal, synovial, pleural, peritoneal, pericardial, and amniotic fluids).
4. Direct contact with concentrated virus.

Infectious status of source

1. Presence of HBsAg.
2. Presence of HCV antibody.
3. Presence of HIV antibody.

Susceptibility of exposed person

1. Hepatitis B vaccine and vaccine response status.
2. HBV, HCV and HIV immune status.

Evaluation of the Exposure Source

Known Sources

Test known sources for HBsAg, anti-HCV, and HIV antibody are:

1. Direct virus assays for routine screening of source patients are **not** recommended.
2. Consider using a rapid HIV-antibody test.
3. If the source person is **not** infected with a blood-borne pathogen, baseline testing or further follow-up of the exposed person is **not** necessary.

4. For sources whose infection status remains unknown (e.g., the source person refuses testing), consider medical diagnoses, clinical symptoms, and history of risk behaviors.
5. Do not test discarded needles for blood-borne pathogens.

Unknown Sources

1. For unknown sources, evaluate the likelihood of exposure to a source at high risk for infection.
2. Consider likelihood of blood-borne pathogen infection among patients in the exposure setting.

Treatment of an Exposure Site

Wounds and skin sites that have been in contact with blood or body fluids should be washed with soap and water; mucous membranes should be flushed with water. No evidence exists that using antiseptics for wound care or expressing fluid by squeezing the wound further reduces the risk of bloodborne pathogen transmission; however, the use of antiseptics is not contraindicated. The application of caustic agents (e.g., bleach) or the injection of antiseptics or disinfectants into the wound is not recommended.

Exposure Report

If an occupational exposure occurs, the circumstances and postexposure management should be recorded in the exposed person's confidential medical record (usually on a form the facility designates for this purpose) (Table 8.3). In addition, employers should follow all federal and state requirements for recording and reporting occupational injuries and exposures.

Clinical Evaluation and Baseline Testing of Exposed HCP

Exposed HCP should be evaluated within hours (rather than days) after their exposure and should be tested for HIV and HBsAg at baseline (i.e., to establish infection status at the time of exposure).

Management of Exposures to HBV

Need for PEP for HBV depends on:
1. HBsAg status of the source.
2. Hepatitis B vaccination and vaccine-response status of the exposed person.

Table 8.3: Recommendations for the contents of the occupational exposure report

1. Date and time of exposure;
2. Details of the procedure being performed, including where and how the exposure occurred; if related to a sharp device, the type and brand of device and how and when in the course of handling the device the exposure occurred;
3. Details of the exposure, including the type and amount of fluid or material and the severity of the exposure (e.g., for a percutaneous exposure, depth of injury and whether fluid was injected; for a skin or mucous membrane exposure, the estimated volume of material and the condition of the skin [e.g., chapped, abraded, intact]);
4. Details about the exposure source (e.g., whether the source material contained HBV, HCV, or HIV; if the source is HIV-infected, the stage of disease, history of antiretroviral therapy, viral load, and antiretroviral resistance information, if known);
5. Details about the exposed person (e.g., hepatitis B vaccination and vaccine-response status); and
6. Details about counseling, postexposure management, and follow-up.

Management of HBV exposure is discussed in Table 8.4.

Management of Exposures to HIV

PEP for HIV

The following recommendations (Tables 8.5 and 8.6) apply to situations when a person has been exposed to a source person with HIV infection or when information suggests the likelihood that the source person is HIV-infected. These recommendations are based on the risk for HIV infection after different types of exposure and on limited data regarding efficacy and toxicity of PEP. Because most occupational HIV exposures do not result in the transmission of HIV, potential toxicity must be carefully considered when prescribing PEP. To assist with the initial management of an HIV exposure, healthcare facilities should have drugs for an initial PEP regimen selected and available for use. When possible, these recommendations should be implemented in consultation with persons who have expertise in antiretroviral therapy and HIV transmission.

Table 8.4: Recommended postexposure prophylaxis for exposure to hepatitis B virus

*Vaccination and antibody response status of exposed workers**	Treatment		
	Source HBsAg positive	*Source HBsAg[1] negative*	*Source unknown or not available for testing*
Unvaccinated	HBIG × 1 and initiate HB vaccine series[0]	Initiate HB vaccine series	Initiate HB vaccine series
Previously vaccinated			
Known responder**	No treatment	No treatment	No treatment
Known nonresponder[00]	HBIG × 1 and initiate revaccination or HBIG × 2***	No treatment	If known high risk source, treat as if source were HBsAg positive
Antibody response unknown	Test exposed person no treatment for anti-HBs[0] 1. If adequate**, no treatment is necessary 2. If inadequate, administer HBIG × 1 and vaccine booster	No treatment	Test exposed person for anti-HBs 1. If adequate[δ], no treatment is necessary 2. If inadequate[δ], administer vaccine booster and recheck titre in 1-2 months

*Persons who have previously been infected with HBV are immune to reinfection and do not require postexposure prophylaxis.
[1]Hepatitis B surface antigen
****Hepatitis B immune globulin; dose is 0.06 ml/kg intramuscularly.
[0]Hepatitis B vaccine.
**A responder is a person with adequate levels of serum antibody to HBsAg (i.e., anti-HBs ≥ 10 mIU/ml).
[00]A nonresponder is a person with inadequate response to vaccination (i.e., serum anti-HBs < 10 mIU/ml).
[δ]The option of giving one dose of HBIG and reinitiating the vaccine series is preferred for nonresponders who have not completed a second 3-dose vaccine series. For persons who previously completed a second vaccine series but failed to respond, two doses of HBIG are preferred

Timing and Duration of PEP: PEP should be initiated as soon as possible (preferably with in 4 hours). The interval within which PEP should be initiated for optimal efficacy is not known.

If appropriate for the exposure, PEP should be started even when the interval since exposure exceeds 36 hours. Initiating therapy after a longer interval (e.g., 1 week) might be considered for exposures that represent an increased risk for transmission. The optimal duration of PEP is unknown. Because 4 weeks of ZDV appeared protective in occupational and animal studies,[4, 18] PEP probably should be administered for 4 weeks, if tolerated.

Use of PEP When HIV Infection Status of Source Person is Unknown

The following are recommendations regarding HIV postexposure prophylaxis:

1. If indicated, start PEP as soon as possible after an exposure.
2. Re-evaluation of the exposed person should be considered within 72 hours postexposure, especially as additional information about the exposure or source person becomes available.
3. Administer PEP for 4 weeks, if tolerated.
4. If a source person is determined to be HIV-negative, PEP should be discontinued.

Agents for PEP

Three classes of drugs are available for the treatment of HIV infection:

1. Nucleoside reverse transcriptase inhibitors (NRTIs),
2. Nonnucleoside reverse transcriptase inhibitors (NNRTIs),
3. Protease inhibitors (PIs).

Determining which agents and how many to use or when to alter a PEP regimen is largely empiric. Usually two drug combination is recommended for PEP (e.g., nucleoside analogues with a PI). But sometimes three drug combination is given;[19] however, the applicability of these recommendations to PEP remains unknown.

Table 8.5: Recommended HIV postexposure prophylaxis for percutaneous injuries

	Infection status of source				
Exposure type	*HIV-positive Class 1**	*HIV-positive class 2**	*Source of unknown HIV status*[β]	*Unknown source*[δ]	*HIV-Negative*
Less severe[00]	Recommend basic 2-drug PEP	Recommend expanded 3-drug PEP	Generally, no PEP warranted;[000] nowever, consider basic 2-drug PEP** for source with HIV risk factors[0]	Generally, no PEP warranted; however, consider basic 2-drug PEP[0] in settings where exposure to HIV-infected persons is likely	No PEP warranted
More severe[0]	Recommend expanded 3-drug PEP	Recommend expanded 3-drug PEP	Generally, no PEP warranted;[000] however, consider basic 2-drug PEP** for source with HIV risk factors[0]	Generally, no PEP warranted; however, consider basic 2-drug PEP[0] in settings where exposure to HIV-infected persons is likely	No PEP warranted

*HIV-positive, class 1—asymptomatic HIV infection or known low viral load (e.g., < 1,500 RNA copies/ml). HIV-positive, Class 2—symptomatic HIV infection, AIDS, acute seroconversion, or known high viral load. If drug resistance is a concern, obtain expert consultation. Initiation of postexposure prophylaxis (PEP) should not be delayed pending expert consultation, and, because expert consultation alone cannot substitute for face-to-face counseling, resources should be available to provide immediate evaluation and follow-up care for all exposures.

[β]Source of unknown HIV status (e.g., deceased source person with no samples available for HIV testing).

[δ]Unknown source (e.g., a needle from a sharps disposal container).

[00]Less severe (e.g., solid needle and superficial injury).

**The designation "consider PEP" indicates that PEP is optional and should be based on an individualized decision between the exposed person and the treating clinician.

[000]If PEP is offered and taken and the source is later determined to be HIV-negative, PEP should be discontinued.

[0]More severe (e.g., large-bore hollow needle, deep puncture, visible blood on device, or needle used in patient's artery or vein).

Toxicity Associated with PEP

Nearly 50% of HCP experience adverse symptoms (e.g., nausea, malaise, headache, anorexia, and headache) while taking PEP and that approximately 33% stop taking PEP because of adverse signs and symptoms.[4, 20] Some studies have demonstrated that side effects and discontinuation of PEP are more common among HCP taking three-drug.

PEP for Pregnant HCP Pregnant HCP should be approached as with any other person who has had an HIV exposure. However, the decision to use any antiretroviral drug during pregnancy should involve discussion between the woman and her health-care provider(s) regarding the potential benefits and risks to her and her fetus.

Certain drugs should be avoided in pregnant women. EFV is not recommended during pregnancy due to teratogenic effects.

Recommendations for the Selection of Drugs for HIV PEP

Because PEP is potentially toxic, its use is not justified for exposures that pose a negligible risk for transmission. a "basic" two-drug regimen that should be appropriate for most HIV exposures and an "expanded" three-drug regimen that should be used for exposures that pose an increased risk for transmission (Tables 8.5 and 8.6). When possible, the regimens should be implemented in consultation with persons who have expertise in antiretroviral treatment and HIV transmission.

Table 8.6: Recommended HIV postexposure prophylaxis for mucous membrane exposures and nonintact skin* exposures

	Infection status of source				
Exposure type	*HIV-Positive class 1⁰*	*HIV-Positive class 2⁰*	*Source of unknown HIV status⁰*	*Unknown source***	*HIV-negative*
Small volume***	Consider basic 2-drug PEP⁰	Recommend basic 2-drug PEP	Generally, no PEP warranted; however, consider basic 2-drug PEPβ for source with HIV risk factors⁰	Generally, no PEP warranted; however, consider basic 2-drug PEPβ in settings where exposure to HIV-infected persons is likely	No PEP warranted
Large volumeδ	Recommend basic 2-drug PEP	Recommend expanded 3-drug PEP	Generally, no PEP warranted; however, consider basic 2-drug nPEP⁰ for source with HIV risk factors⁰	Generally, no PEP warranted; however consider basic 2-drug PEP⁰ in settings where exposure to HIV-infected persons is likely	No PEP warranted

*For skin exposures, follow-up is indicated only if there is evidence of compromised skin integrity (e.g., dermatitis, abrasion, or open wound)
⁰HIV-positive, Class 1—asymptomatic HIV infection or known low viral load (e.g., < 1,500 RNA copies/ml). HIV-Positive, Class 2—symptomatic HIV infection, AIDS, acute seroconversion, or known high viral load. If drug resistance is a concern, obtain expert consultation. Initiation of postexposure prophylaxis (PEP) should not be delayed pending expert consultation, and because expert consultation alone cannot substitute for face-to-face counseling, resources should be available to provide immediate evaluation and follow-up care for all exposures.
⁰Source of unknown HIV status (e.g. deceased source person with no samples available for HIV testing).
**Unknown source (e.g., splash from inappropriately disposed blood).
***Small volume (i.e., a few drops).
βThe designation, "consider PEP" indicates that PEP is optional and should be based on an individualized decision between the exposed person and the treating clinician.
⁰⁰If PEP is offered and taken and the source is later determined to be HIV-negative, PEP should be discontinued.
δLarge volume (i.e., major blood splash).

Follow-up of HCP Exposed to HIV

Postexposure Testing

HCP with occupational exposure to HIV should receive follow-up counseling, post-exposure testing, and medical evaluation, regardless of whether they receive PEP. HIV-antibody testing should be performed for at least 6 months postexposure (e.g., at 6 weeks, 12 weeks, and 6 months). Extended HIV follow-up (e.g., for 12 months) is recommended for HCP who become infected with HCV following exposure to a source co infected with HIV and HCV.

1. HIV-antibody testing should be performed for at least 6 months postexposure.
2. Direct virus assays for routine follow-up of HCP are not recommended.
3. HIV testing should be performed on any exposed person who has an illness compatible with an acute retroviral syndrome.

SUMMARY OF MANAGEMENT OF OCCUPATIONAL BLOOD EXPOSURES

Universal precautions should always be followed without exception.

Provide immediate care to the exposure site.

1. Wash wounds and skin with soap and water.
2. Flush mucous membranes with water.

Determine risk associated with exposure by:

3. Type of fluid (e.g., blood, visibly bloody fluid, other potentially infectious fluid or tissue, and concentrated virus) and

4. Type of exposure (i.e., percutaneous injury, mucous membrane or nonintact skin exposure, and bites resulting in blood exposure).

Evaluate exposure source.

5. Assess the risk of infection using available information.
6. Test known sources for HBsAg, anti-HCV, and HIV antibody (consider using rapid testing).
7. For unknown sources, assess risk of exposure to HBV, HCV, or HIV infection.
8. Do not test discarded needles or syringes for virus contamination.

Evaluate the exposed person.

9. Assess immune status for HBV infection (i.e., by history of hepatitis B vaccination and vaccine response).

Give PEP for exposures posing risk of infection transmission.

1. Initiate PEP as soon as possible, preferably within hours of exposure.
2. Offer pregnancy testing to all women of childbearing age not known to be pregnant.
3. Seek expert consultation if viral resistance is suspected.
4. Administer PEP for 4 weeks if tolerated.

Perform follow-up testing and provide counseling.

Advise exposed persons to seek medical evaluation for any acute illness occurring during follow-up.

HBV Exposures

Perform follow-up anti-HBs testing in persons who receive hepatitis B vaccine.

1. Test for anti-HBs 1–2 months after last dose of vaccine.
2. Anti-HBs response to vaccine cannot be ascertained if HBIG was received in the previous 3–4 months.

HCV Exposures

1. Perform baseline and follow-up testing for anti-HCV and alanine aminotransferase (ALT) 4–6 months after exposures.
2. Perform HCV RNA at 4–6 weeks if earlier diagnosis of HCV infection desired.
3. Confirm repeatedly reactive anti-HCV enzyme immunoassays (EIAs) with supplemental tests.

HIV Exposures

1. Perform HIV-antibody testing for at least 6 months postexposure (e.g., at baseline, 6 weeks, 3 months, and 6 months).
2. Perform HIV antibody testing if illness compatible with an acute retroviral syndrome occurs.
3. Advise exposed persons to use precautions to prevent secondary transmission during the follow-up period.
4. Evaluate exposed persons taking PEP within 72 hours after exposure and monitor for drug toxicity for at least 2 weeks.

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9 Operating Tables, OT Lighting and Positions for Vaginal Surgery

Medha Mohta, Tarun Bhagchandani

INTRODUCTION

Vaginal surgery includes procedures on vaginal wall, cervix, uterus and repair of genital fistulas. Most of these procedures are performed in lithotomy position, however, a few require other positions e.g. knee-chest. Laparoscopic surgery e.g. laparoscopy assisted vaginal hysterectomy may require use of modified lithotomy with a steep Trendelenburg's position.

Optimal exposure of surgical site and thus success of surgery depends, to a large extent, upon proper positioning. Many types of operating tables along with different control mechanisms and accessories are available to achieve diverse positions for all surgical specialties. Knowledge about these operating tables, their parts, accessories and their function are essential for good surgical exposure as well as patient safety.

Another requirement for good surgical conditions is proper illumination of the surgical field. To achieve this aim, adequate lighting of both operating theatre and operating table are important. The principles regarding this are essentially the same for all types of surgical procedures.

Operating Tables

Parts

An operating table consists of a table top, base and a column (Fig. 9.1). The table top is a rectangular metal top, supported by the column and the base. The column contains lifting mechanism which can be hydraulic or electro-hydraulic. The top should be made of corrosion resistant materials; the commonly used ones are stainless steel and aluminium. The base and column are also

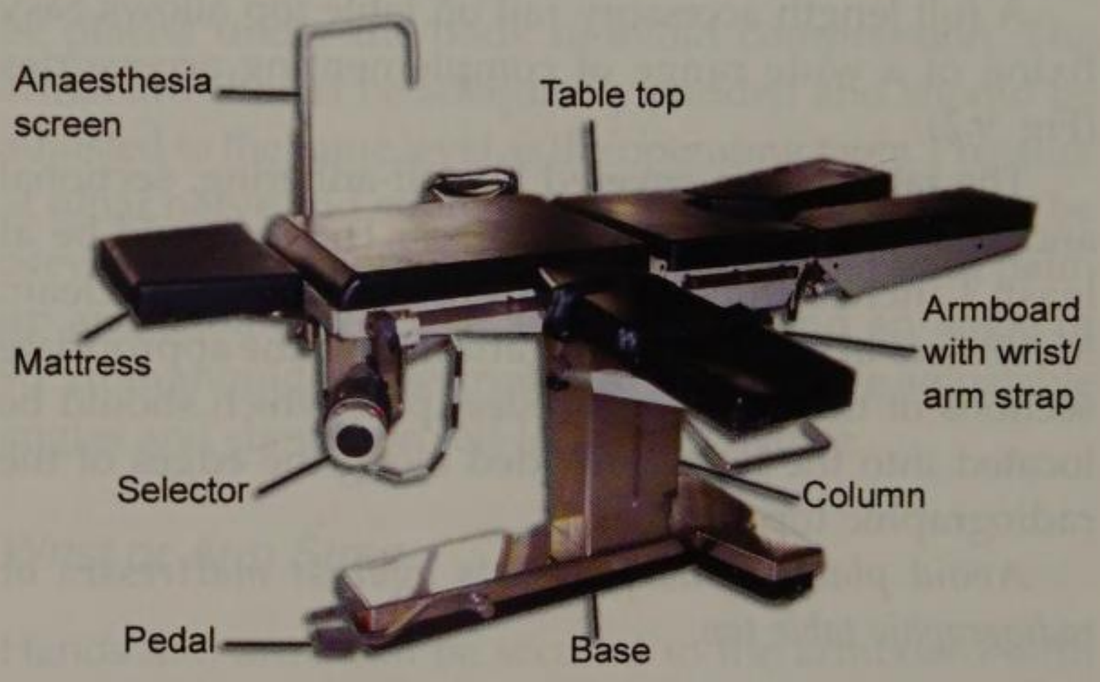

Fig. 9.1: An operating table showing different parts and accessories

usually covered with stainless steel fittings for hygiene and durability.

The table top is made up of three or more hinged parts i.e. head, body (trunk) and leg sections.[1] Some recent operating tables have up to six sections of table top. The head section is usually detachable. The leg section can be fully lowered or, if preferred, removed altogether. Tables with divided leg sections are also available. Various parts can be flexed or extended to make the required position. The movement at joints of the table is called 'breaking the table' and these joints are known as 'breaks.' Other movements possible in an operating table are raising, lowering, Trendelenburg, anti-Trendelenburg and lateral tilts of the entire table top.

The adjustment ranges i.e., the degree to which different movements are possible in a particular operating table, are given in the user's manual provided by the manufacturer. Some operating tables designed for

gynaecological surgery have a perineal section between trunk and leg sections. The leg and perineal sections are removable and the combined head and main trunk sections can be 'traversed' with the patient in lithotomy position, to facilitate gynaecological procedures.

While adjusting the table, ensure that the patient's fingers, hands or other parts of the body are not caught between moving parts of different sections.

The table top is X-ray transluscent. A continuous tunnel from end to end beneath the radiographic top allows X-ray photography along full length of the patient's body without the need to move the patient. The X-ray cassette tray can be introduced from either end of the table or from the side of the table. An image intensifier can also be used.

A full length accessory rail on table top allows easy fixing of a wide range of complementing accessories (Fig. 9.2).

The table top is covered by self-adhering, sectional and conductive rubber mattresses. These should be at least 3 inches thick, water-proof and easy to clean. Mattresses in some tables are attached to the appropriate sections of the table top by steel pins which should be located into the holes provided along the edges of the radiographic top.

Avoid placing sharp objects against mattresses or radiographic table top.

Control Mechanisms

All tables have control mechanism to achieve desired positions by manipulating different parts. Some are manually controlled, whereas movements of others are electrically controlled.

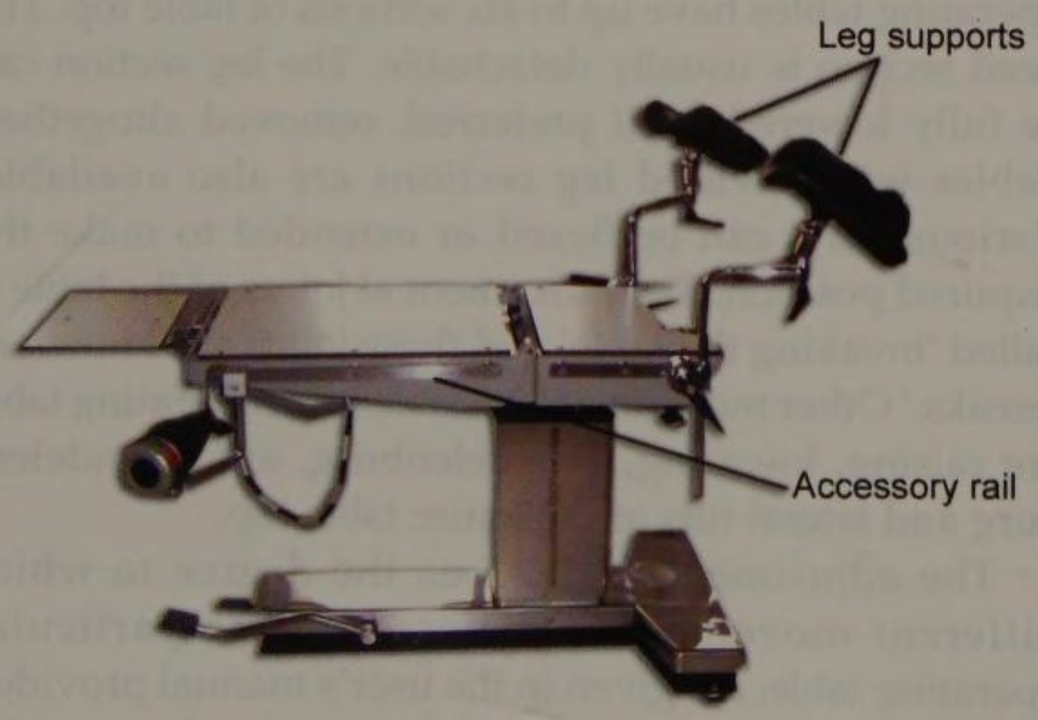

Fig. 9.2: Operating table with leg supports

Manually controlled (hydraulic mechanism)—Various movements are controlled by a gear box (selector) and pedal at the head of the table (Figs 9.1 and 9.3). Selector is turned until the desired setting symbol is at the indicator. Pumping or raising the pedal results in the desired movement.

Some tables have two separate control handles, one on each side of the trunk section towards the head end for Trendelenburg/reverse Trendelenburg and for lateral tilt. Some others have change-over pedals to select the desired movement (Fig. 9.4). The selected pedal is inclined in the required direction and a pump pedal is stepped upon repeatedly to carry out the movement.

Electrically controlled (electro-hydraulic mechanism)—Control is by remote hand or foot control switches (control unit) (Fig. 9.5) or a lever-operated electro-hydraulic system. Adjustment symbols on the control unit should be clearly visible even in low-light environment such as might be required in laparoscopic surgeries. This type of table has electrical connection and the power cord is to be plugged into medical grade wall outlet. Uninterrupted power supply is essential for manipulation of this table. Some tables have battery back-up in which case batteries should be kept fully charged.

All operating tables are movable and can be locked for stabilization by a brake or floor lock (See fig. 9.3). Some tables have two mobile positions-castor and wheel; and a brake position. All these are operated from a control pedal assembly at one end of the table base. The wheel position is used for moving the table between locations,

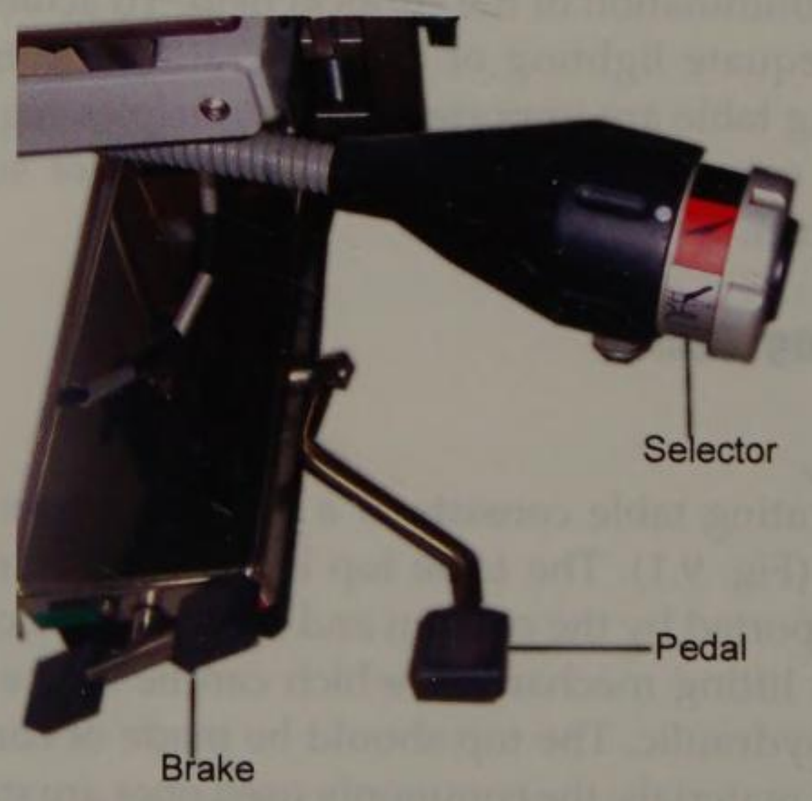

Fig. 9.3: A table showing manual (hydraulic) control mechanism with selector and pedal

Fig. 9.4: A table showing manual (hydraulic) control mechanism with change-over pedals and pump pedal

Fig. 9.5: Operating table showing electro-hydraulic control mechanism. Inset—Control unit

whereas in castor position, the table is free to move in any direction, for accurate positioning. The castors are swiveling wheels which allow easy maneuverability of table. These should be antistatic and smoothly rolling.

Accessories

Armboard/armrest (Fig. 9.1)

Armboards are required to support outstretched arms. During surgery intravenous fluids are infused and it is important to keep at least one hand and arm straight to enable smooth flow of fluid. Moreover, it is not possible to keep the arms on the table beside the body during vaginal surgery because of the stirrups required to put the patient in lithotomy position. The hands must never be placed under the body to avoid compression. The armboard should be adequately padded and should be adjusted to the same level as the operating table. Pressure at ulnar nerve and stretching of brachial plexus must be prevented. Therefore, arms should be placed with palm up and should never be abducted beyond an angle of 90° from shoulder. The armboard should have adjustable angles and should be self-locking in nature.

Wrist or Arm Strap

Hands and arms can be secured to the armboard with narrow straps, at least 1.5 inches wide (See fig. 9.1). But these straps should not exert pressure or tourniquet effect on the wrist.

Patient Restraint Strap

It attaches to the side rail with stainless steel hooks and adjusts to the patient with buckles. The strap should be constructed of strong conductive, reinforced rubber for durability and ease of cleaning.

Stirrups

Legs and feet of the patient need to be supported in lithotomy position. For this, metal stirrup posts are fixed in holders on both sides of the operating table. The feet are supported by canvas or fabric loops and the legs are suspended at right angle to the feet. These are also called candy cane or sling stirrups.[1]

Leg Supports/Padded Knee Crutches

Leg supports with clamps are available which are padded and have Velcro straps and a ball joint (Fig. 9.2).

Gas Spring Assisted Stirrups

These help to change position intra-operatively in procedures such as laparoscopic assisted vaginal hysterectomy. These are provided with side rail clamps and lightweight molded boots. Each stirrup joint has lithotomy degree indicators.

Bowel

A stainless steel bowl can be fixed with a clamp to the side rail or under the table top.

Long Gynecologic Section

Many tables have a separate perineal section. Some others have a provision for attachment of a long gynecologic section that gives more space for the surgeon.

Anaesthesia Screen (Fig. 9.1)

After induction of anaesthesia and positioning of patient, it is important to separate the non-sterile from sterile area. Most anaesthesiologists prefer to have their field separated from the surgeon's field. It allows them to have a better access to the head end of the patient and also minimizes disturbances to the monitoring devices. For this purpose, an anaesthesia screen is used. It is a metal bar which can be attached to the head end of the operating table to hold the drapes from the patient's face. It is adjustable and allows rotation or angling.

Infusion Rod

Some operating tables also have provision for attaching an infusion rod along with a fixing clamp to the side rail. It has adjustable height.

Positioning on Operating Table

Lithotomy Position (Figs 9.6 and 9.7)

This is a modification of the supine position in which knees and hips are flexed, and the hips are abducted to permit surgical access to the perineum.[2]

Before placing the patient in lithotomy position, she is shifted down the table so that her buttocks lie along the break between the body and leg sections of the table. Stirrup posts are fixed in holders on each side of the table at the level of the patient's upper thighs. The height of

Fig. 9.6: Lithotomy position, as viewed from the side of the patient

Fig. 9.7: Lithotomy position, as viewed from the head-end of the patient

stirrups should be equal on both the sides and it should be adjusted according to length of the patient's legs so as to maintain symmetry after patient positioning. Two people are required, one on each side of the table, to position the patient. Both legs of the patient are raised simultaneously. Each person holds the sole of a foot in one hand and supports the calf with the other. Knees are flexed and the feet are placed in canvas slings of the stirrups so that one loop encircles the sole and the other loop supports the ankle with the legs between the stirrup posts. Movement of both the limbs must be simultaneous. It keeps the body in alignment and prevents torsion of lumbar spine, which can lead to debilitating post-operative pain.[3] The legs are positioned on inner side of the stirrup posts and excessive abduction or external rotation of limbs is avoided. Adequate padding should be placed so that the limbs do not come in contact with

metal stirrup. Nowadays padded leg supports are available which make positioning simpler. In these, legs are placed and strapped over these supports. After positioning the limbs, mattress over the leg section of table is removed and this section lowered or removed. The position is again checked and adjustments made, if required. The buttocks should be even with the edge of the table. If these extend beyond the edge, there is strain on lumbosacral muscles and ligaments.

In tables having separate perineal section and other sections which can be traversed, lithotomy poles are raised and the patient's feet are placed in the stirrups without moving the patient. Perineal section is removed together with mattresses of perineal and leg sections. After freeing the traverse lock (on side of table trunk section), the combined head and trunk sections can now be moved to cover the position previously occupied by the perineal section until the assembly locks in position.

After the procedure is over, leg section of the table is raised and its mattress replaced. Both the legs are removed from the stirrups or leg supports, fully extended and brought together to prevent abduction of thighs. All the movements should take place simultaneously on both sides.

Arms should be placed on armboards. Keeping the arms on lower abdomen can cause accidental interference with the surgical field and instruments. Placement on chest can hinder diaphragmatic movement. If arms are placed on the table along the body, hands can get injured in the break of the table during manipulations.

Lithotomy position may be associated with certain problems that need special attention.

1. Femoral neuropathy has been reported following many cases performed in lithotomy position for a prolonged duration.[4,5] Flexion, abduction and external rotation of hip in this position can cause compression of blood supply of femoral nerve leading to local ischemia of nerve trunk.

   Nerve damage or compartment syndrome can also occur if positioning is not proper or undue pressure is exerted on the thighs or legs of the patient.[1,2] Common peroneal nerve damage can occur due to compression between the head of the fibula and lithotomy pole.

   Assistant surgeons should remain careful and should not rest their arms or put pressure on the patient's limbs while assisting vaginal procedures.
2. If, due to inadequate effect or wearing of regional anaesthesia, general anesthesia is to be induced during the procedure, the position needs to be changed to supine. Risk of regurgitation and thus aspiration is increased in lithotomy position due to increased intra-abdominal pressure. Further, if reflux or vomiting occurs during induction, turning the patient will be delayed. Thus, anaesthesia should never be induced in this position.
3. Vital capacity is decreased. Therefore, respiration should be carefully monitored in sedated, spontaneously breathing patients.
4. Autotransfusion from leg vessels increases preload. The effect on cardiac output will depend on the patient's volume status. In case of significant surgical bleeding, autotransfusion may mask the extent of blood loss.[2] However, when legs are lowered at the end of surgery, depending on degree of vasodilatation, 500 to 800 ml of blood may drain back into lower limbs. This sudden shift of blood volume can cause hypotension. Therefore, *this movement must be very slow, smooth and gentle.*

Knee-Chest Position

This position is used for culdoscopy and repair of vesicovaginal fistulae, especially juxtaurethral, by some surgeons.[6] It is a modification of prone position.

After turning the anaesthetized patient into prone position, her pelvis and chest are lifted and pillows or soft supports are placed under the chest and the pelvis. The legs, placed on the divided leg sections, are separated sufficiently to allow access. The lower part of the table is broken so as to achieve the position shown in Figure 9.8. The patient's head is supported on a small pillow or soft horseshoe ring with minimal rotation of the neck. The arms are placed around the head with elbows flexed.

While placing a patient in knee-chest position, certain points should be kept in mind:[3]

1. Adequate number of assistants should be available. The anaesthesiologist supports the head and neck, whereas minimum of three assistants are required to hold and position rest of the body.
2. Alignment of spine should be maintained at all times during positioning.
3. The neck must not be over-flexed or hyper-extended.
4. Chest supports should not encroach onto epigastrium or neck and the anterior abdominal wall should remain completely free.
5. Pressure on the eyes must be prevented as compression on the globe of the eye can lead to corneal abrasion and even blindness.

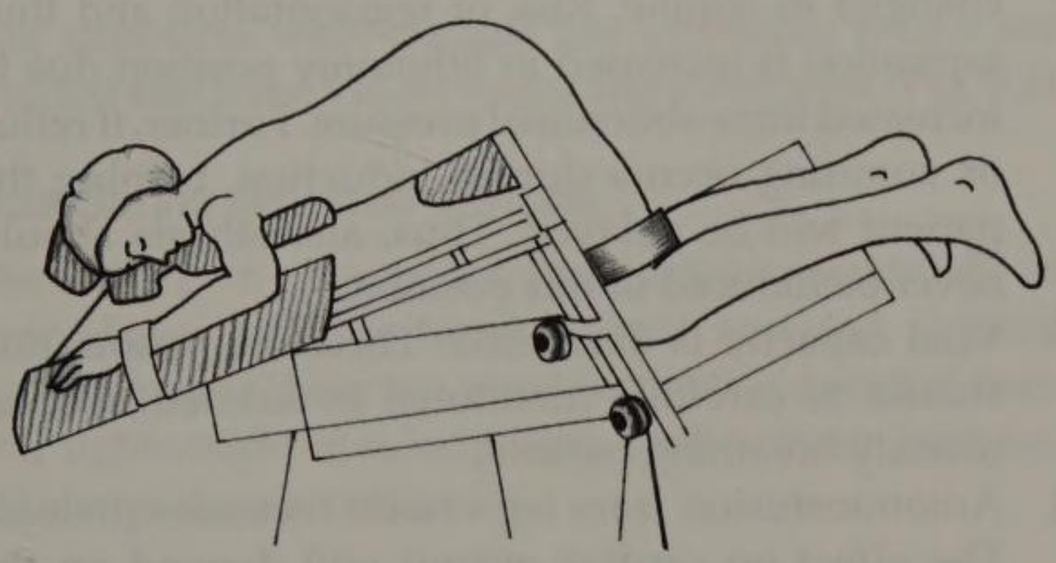

Fig. 9.8: Knee-chest position

Fig. 9.9: Reverse lithotomy position

6. The patient's breasts must be protected. Whenever possible, these should be directed medially and cephalad.
7. Area around the ulnar nerve must be padded well.
8. There is a risk of injury to brachial plexus when the patient's arms are extended above the head. The upper arm should be placed at an angle equal to or less than 90° to the trunk with the forearms parallel to it.

Reverse Lithotomy with Head-up Tilt

This is also a modification of prone position. This position is preferred by some surgeons for vesico-vaginal-fistula repair by vaginal route. It allows good exposure of bladder neck and subsymphysial fistulae.[7]

The patient is placed in prone position with knees abducted and head-up tilt of the table. The ankles are lifted up and supported by the stirrups (Fig. 9.9).

Modified Lithotomy with Trendelenburg (Lloyd-Davies Position)

For procedures, where combined perineal and abdominal surgical approach is required e.g. laparoscopic gyneco-logical procedures, the preferred position is modified lithotomy with a considerable degree of head-down tilt (Trendelenburg) and the patient's buttocks overhanging the end of the operating Table.[8]

Patient's legs are comfortably supported beneath the knees in obstetric stirrups. The calves are gently strapped onto the stirrups so that the patient does not slide towards the head end during steep Trendelenberg position. This also obviates the need to fix shoulder stops, thus preventing the common complication associated with their use i.e. transient brachial plexus paralysis.[9] Access to perineum is secured by abducting the thighs and also placing a firm pad beneath the sacrum so that the sacrococcygeal articulation projects 2.5-3.0 cm beyond the distal edge.[2] The thighs are not so flexed as in the conventional lithotomy position, in order to allow better surgical access to the abdomen. Finally the table is given Trendelenburg tilt which is necessary to have an optimal view inside the abdomen, by removing gut away from the surgical field.

The left arm of the patient is kept on her side to provide space for surgeon. The right arm is put on an armrest and is available to the anaesthesiologist for intravenous cannulation and attaching monitoring equipment. An appropriate arrangement of operating room team and the equipment is shown in Figure 9.10.

The patient's eyes must be guarded by adequate padding and taping to prevent inadvertent trauma by surgeons or long laparoscopic instruments.[8]

Cleaning and Disinfection

The operating table must be cleaned before and after completion of every surgical procedure. It should be washed with soap and minimum water only. Hard brushes and cleansing powders are to be avoided as they might damage the painted surface of the table. Immediately after cleaning or disinfecting, the table should be dried thoroughly by wiping it down. The table with electro-hydraulic mechanism should never be flushed with water.

The mattresses should be wiped with a mild alkaline detergent, having a pH of 7-8. Soap and minimum water can be used for this purpose. Do not apply sodium hypochlorite disinfectants, abrasive cleaning powders or solvents, e.g. petroleum spirit, carbon tetrachloride or trichloroethylene on the mattresses.

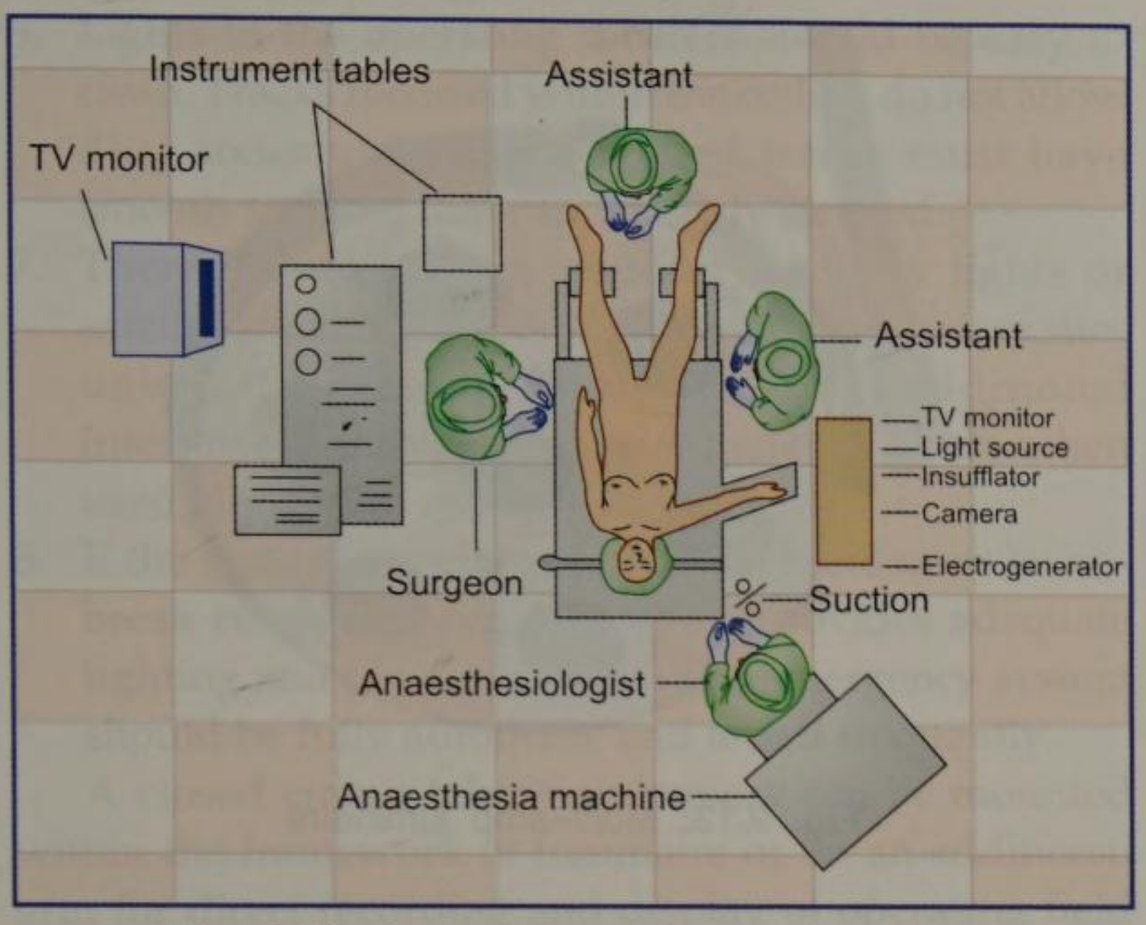

Fig. 9.10: Operating room arrangement for laparoscopic surgery

For disinfection, specific disinfectants can be used in accordance with the manufacturer's recommendations.

Operating Theatre Lighting

Lighting in operating room has two components i.e., general lighting and lighting of surgical area.

For general lighting, white fluorescent or incandescent ceiling lights are used which are recessed or surface mounted. These should be arranged to produce even illumination of the room. The light should be adequate to evaluate patient's colour. Also to minimize eye fatigue, the ratio of intensity of general room lightning to that at the surgical site should not exceed 1:5.[10] However, it should be possible to decrease intensity or completely switch off lights for endoscopic procedures. Along with artificial lighting, some natural daylight is always preferred. Whenever possible, high level windows are provided for visual appreciation of the outer world. In this case, solar gain or loss should be taken care of, as it may affect control of environmental condition. There must be a provision to completely black out the windows for various endoscopic vaginal surgeries.

Illumination of the surgical site depends upon:

1. Quality of light from an overhead source—It should enable recognition of pathological conditions,
2. Reflection from drapes and tissues—Dull and dark tissues need more light than white glistening tissues.

Types of Operating Lights (Luminaires)

Most operating lights are mounted on the ceiling, but sometimes mobile lights are also used, especially in emergency situations or when additional light source is needed (Fig. 9.11). Usually the operating lights have halogen bulbs. These emit light with a pale bluish cast which is very intense but causes less fatigue to eyes than other lights of the same intensity. Moreover, these bulbs are safer used near tissues as more of the energy is released as light than as heat.[11]

Operating luminaires may be of mainly two types:

Multi-Reflector Luminaires (Fig. 9.12)

These contain a single lamp and an optical lens with a reflector surface, surrounding inner surface of luminaire and set at 45° from the centre of the lamp. This reflector surface can be made up of mirrors or a concave, highly polished metallic surface. Light rays from the lens are projected on to the reflector surface, from where these are projected on to the operating area (task area). For focusing, lamp can be moved up and down within the lens. In some multi-reflector luminaires, an extra-lamp is provided which switches on automatically in case of failure of the first lamp.

Fig. 9.11: Mobile operating light

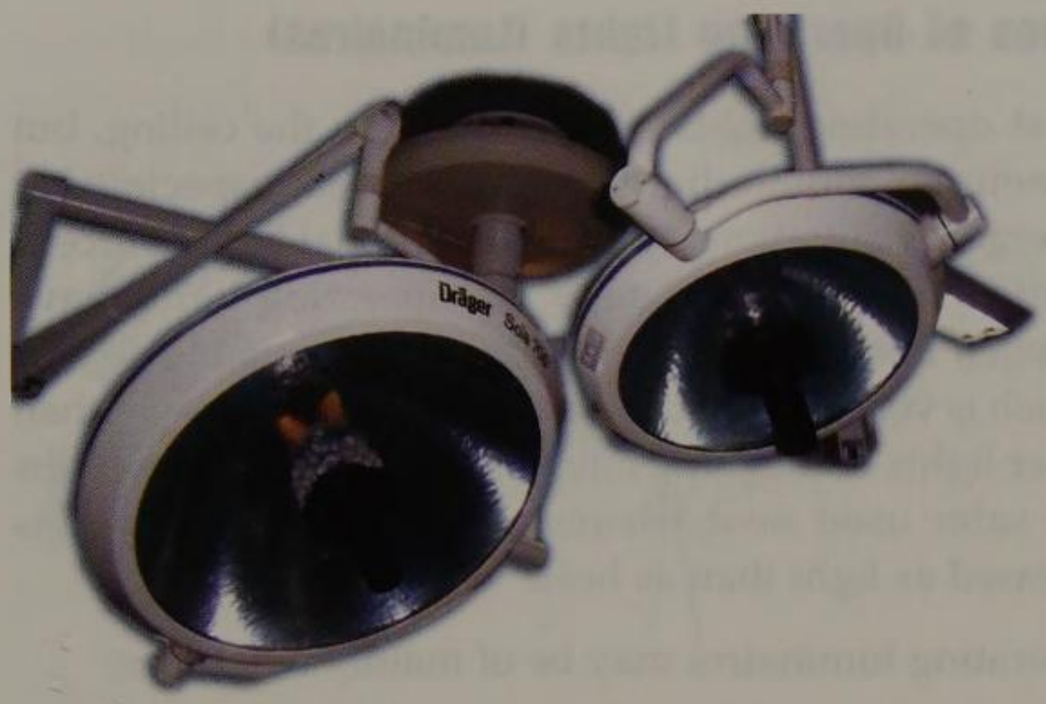

Fig. 9.12: Multi-reflector luminaire

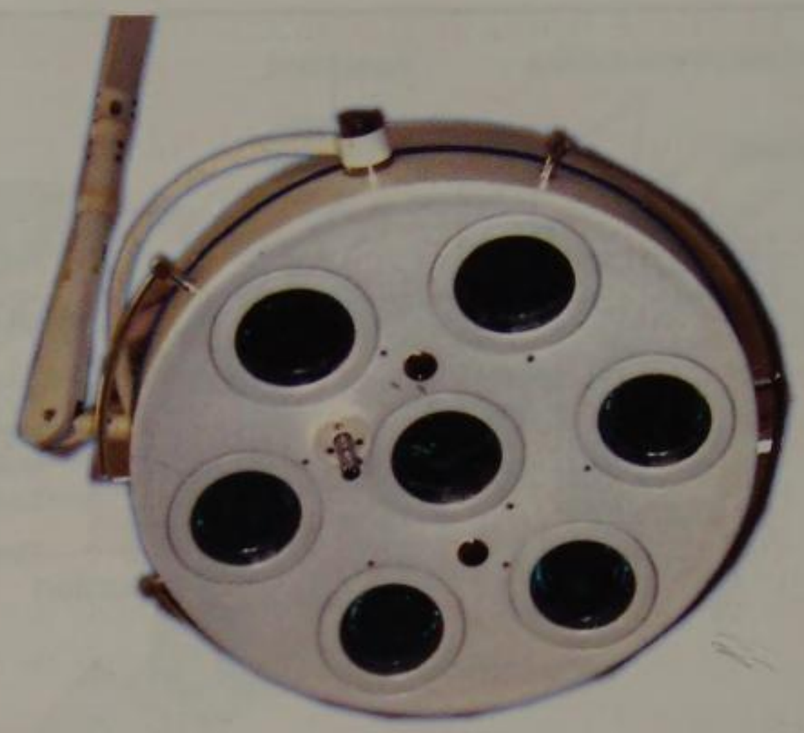

Fig. 9.13: Multi-lamp luminaire

Multi-Lamp Luminaires (Fig. 9.13)

These contain multiple lamps fitted in a single housing. Focus can be adjusted by a knob or switch fitted on the outer side of housing. The main advantage of this type of light is that if one lamp fails during operation, the intensity of light is not affected significantly and the surgery can be completed without changing the lamp.

Some luminaires have dual tracks with two light domes. These lights are designed to be used simultaneously to provide adequate intensity and minimize shadows.

Following are some requirements and desirable features of operating room lights:[10,12]

1. The operating light must produce a diameter light pattern and it should focus appropriately for size of incision. Most lights focus on a central point which is surrounded by a wider, less intense area of illumination. The light must also give contrast to the depth and relationship of all anatomic structures. The light must be equipped with an intensity control. With the luminaire at approximately 1000 mm (40in) from the operative area, the light pattern should be at least 200 mm (8in) in diameter, with the light intensity between 50,000 and 100,000 lux at centre and at least 15,000 lux at the periphery. This intensity of light required for surgical site is very high in comparison to 500 lux required for general lighting. This is because of high level of absorption and low degree of reflection of light from the tissues as the part of light absorbed does not contribute to visibility.
2. The surgeons should be able to differentiate between normal and diseased tissues and perform tasks with materials having little color contrast. To achieve this aim, the colour temperature of light should be around 4000 Kelvin. Colour temperature is a measure of the hue that a light emits. Halogen lamps have a higher colour temperature than incandescent lights.
3. To avoid shadows being created by surgical team's hands and head, the beams of light should be produced from a variety of angles. Multiple light sources or reflectors help to reduce shadows.
4. Operating room lights should be freely adjustable to any position or angle by either vertical or horizontal range of motion. The ceiling-mounted luminaire should be suspended and counter balanced in a way so as to allow easy movement and it should not vibrate or drift after positioning. Some removable, sterile handles should be fitted at the centre of the light at beginning of surgery, to enable the surgeons to make fine adjustments. These handles may be made up of reusable aluminium or steel; or a disposable material.[11]
5. The heat produced from light beams should be as low as possible to prevent drying out or burning of delicate tissues. Lamps should produce less than 25,000 $\mu W/cm^2$ of radiant energy. This should be kept in mind while using multiple light sources, the total energy produced by all the lamps must not exceed this limit at one surgical site.

   Nowadays, most operating luminaires use dichroic reflectors (cold mirrors) to reduce the amount of heat produced by the light rays. Dichroic reflectors transmit heat producing infra-red energy backwards for dissipation by the luminaire housing, while reflecting visible radiation as a light beam.

6. Lights in the operating theaters should be easy to clean. Tracks recessed within the ceiling do not allow dust accumulation. Suspended tracks must have smooth surfaces that can be easily cleaned.
7. There should be provision for auxiliary lights or satellite units. They should be used for secondary sites unless the manufacturers state that additional intensity is within safe radiant energy levels when used along with main light.
8. If the main electricity supply fails, there must be no-break emergency supply, which provides adequate lighting and power back up. The emergency system should be fully automatic and tested frequently.

A closed circuit television camera can be mounted within the framework of luminaire or on an additional arm for direct recording and display of operating field to the personnel outside the operating room.

CONCLUSIONS

All members of operating theatre staff should be familiar with and have practical knowledge about operating tables, their accessories and theatre lights. This is essential to obtain optimal exposure with sufficient illumination along with ensuring patient's safety during surgical procedure.

Key Points

1. Proper positioning of patient on operating table and good illumination of the surgical field are the essential pre-requisites for success of vaginal surgery.
2. The various movements that are possible in an operating table include raising, lowering, Trendelenburg, anti-Trendelenburg and lateral tilts of the entire table top; or movements at joints of the table. The control of these movements may be manual or electrical.
3. While adjusting the table, care should be taken to prevent the patient's fingers, hands or other parts of the body from getting caught between moving parts of different sections.
4. A number of accessories may be available along with an operating table e.g. armrest, wrist/arm strap, patient restraint strap, stirrups or leg supports, bowl, long gynecologic section, anaesthesia screen or infusion rod. It is important to know their functions so as to be able to use them correctly.
5. *Lithotomy* is the most commonly used position during vaginal surgery; however, the problems associated with its use must be kept in mind and necessary precautions taken.
6. Sometimes *knee-chest position* or *reverse lithotomy with head-up tilt* are also used by some surgeons to repair vesico-vaginal fistulae by vaginal route.
7. *Modified lithotomy with Trendelenburg position* is the preferred position for procedures involving combined perineal and abdominal surgical approach e.g. laparoscopic gynecological procedures.
8. Lighting in operating room includes general lighting as well as lighting of surgical area.
9. White fluorescent or incandescent ceiling lights can be used to provide adequate and even illumination of operating room. However, there should be a provision to darken the room for endoscopic procedures.
10. Operating luminaires may be m*ulti-reflector or multi-lamp luminaires.*
11. The operating light should focus appropriately for size of incision, should be freely adjustable to any position or angle, must be equipped with an intensity control and must have a no-break emergency electricity supply.
12. The heat produced by operating light should be as low as possible. Dichroic reflectors (cold mirrors) reduce the amount of heat produced by the light rays.

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10 Electrosurgical Cautery Units

Manpreet Singh, Namita Grover

INTRODUCTION

Electrosurgery consists of the generation and delivery of radiofrequency current between an active electrode and a dispersive electrode to elevate tissue temperature for the purpose of coagulating, cutting, fulguration, or desiccation. Despite various myths about the risks of electrosurgery, modern electrical equipments are finely tuned instruments that offer many versatile variables for the contemporary surgeon to harness, allowing the surgeon to deliver energy to tissue in either a discrete or broad manner to obtain a desired effect and outcome.[1] The main advantage of this surgical modality is rapid completion of the procedure with minimal surgical time, because hemostasis occurs at the time of the incision.

Fundamentals of Electrosurgery

Electrosurgery is a procedure that cuts, destroys, or cauterizes tissue using a high-frequency electric current applied locally with a pencil-shaped metal instrument or needle. The major techniques that may be involved in the electrosurgery step include electrodesiccation (removal of water), fulguration (production of a spark to destroy tissue), electrocoagulation (forming blood clots to stop bleeding), and electrosection (cutting). The correct output power is determined by starting at low power and increasing the power level until the desired result is achieved.

Electrocautery involves use of direct current to heat metal conductor with high impedance to flow so that the metal becomes physically hot. The tissue is then cauterized by touching the hot metal object to tissue. *Electrogenerators* are machines that produce an alternating current of electricity at frequency that does not stimulate muscle activity. The direct current flows in one direction only, alternating current flows to and fro, first increasing to a maximum in one direction and then increasing to a maximum in the other direction. The sinusoidal waveforms can be interrupted or varied. The waveform of alternating current has a negative and a positive excursion, or peak. As it passes through each cell, the electric polarity is agitated, creating cellular heat (Fig. 10.1).

A pure cutting–desiccation (CUT) waveform is a simple sinusoidal, undamped, or nonmodulated waveform and is generally produced by continuous energy (Fig. 10.2). An output waveform that is interrupted or varied is called as coagulating (COAG) waveform (Fig. 10. 3).

When there is continuous flow or waveform, the peak voltage need not be as high as with the COAG waveform to create same wattage. When a coagulation effect is enhanced, the damped waveform is preferable and is

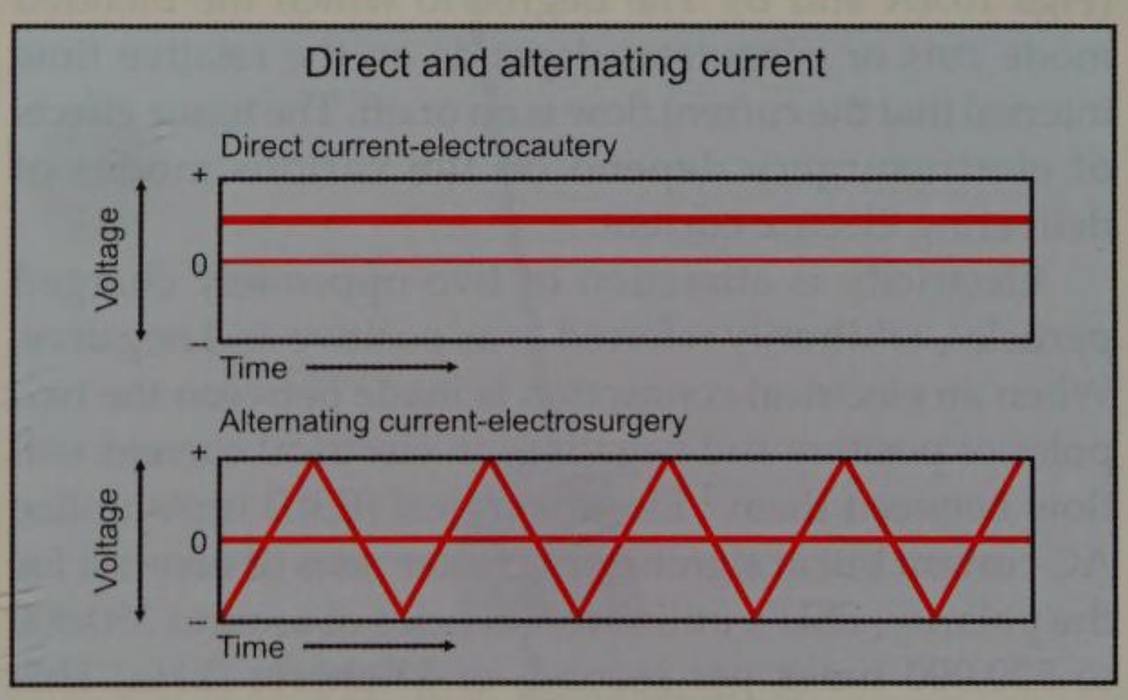


Fig. 10.1: Type of current

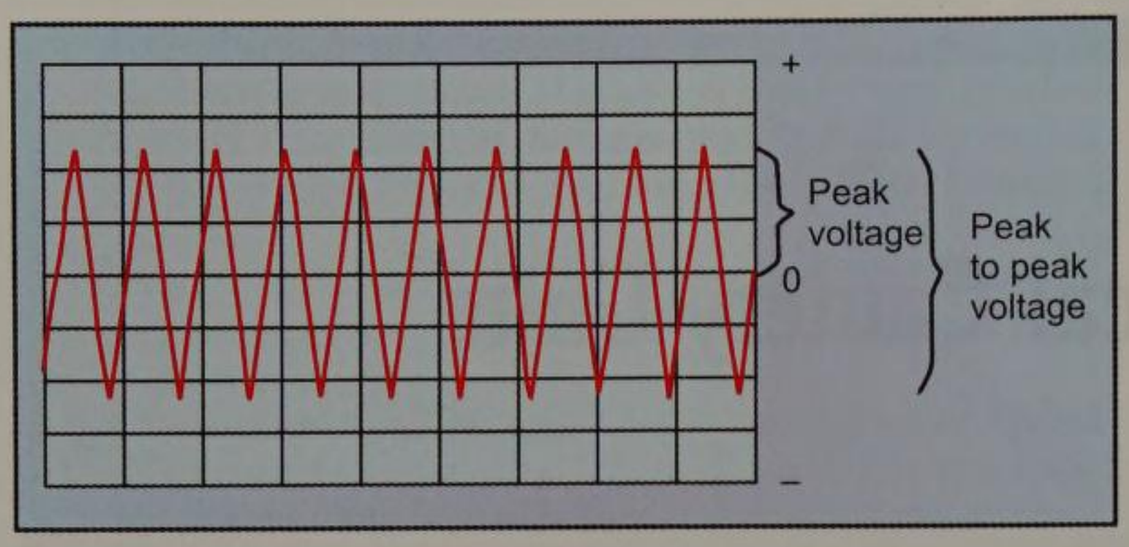


Fig. 10.2: Undamped or CUT waveform

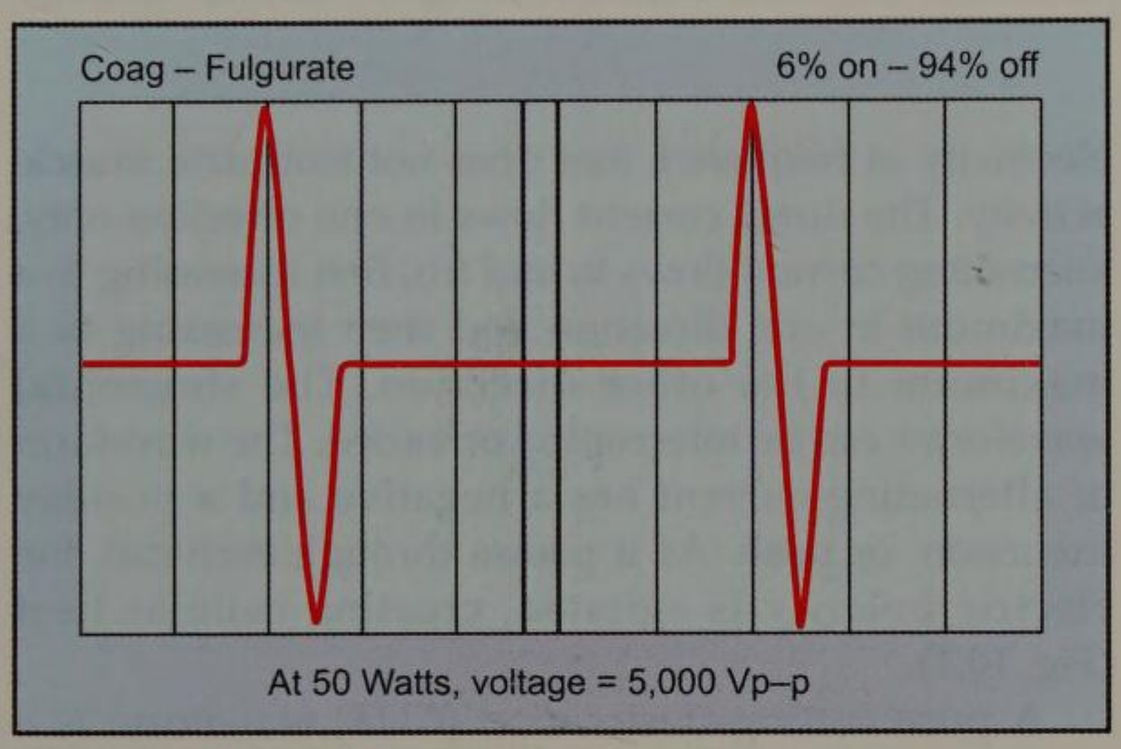
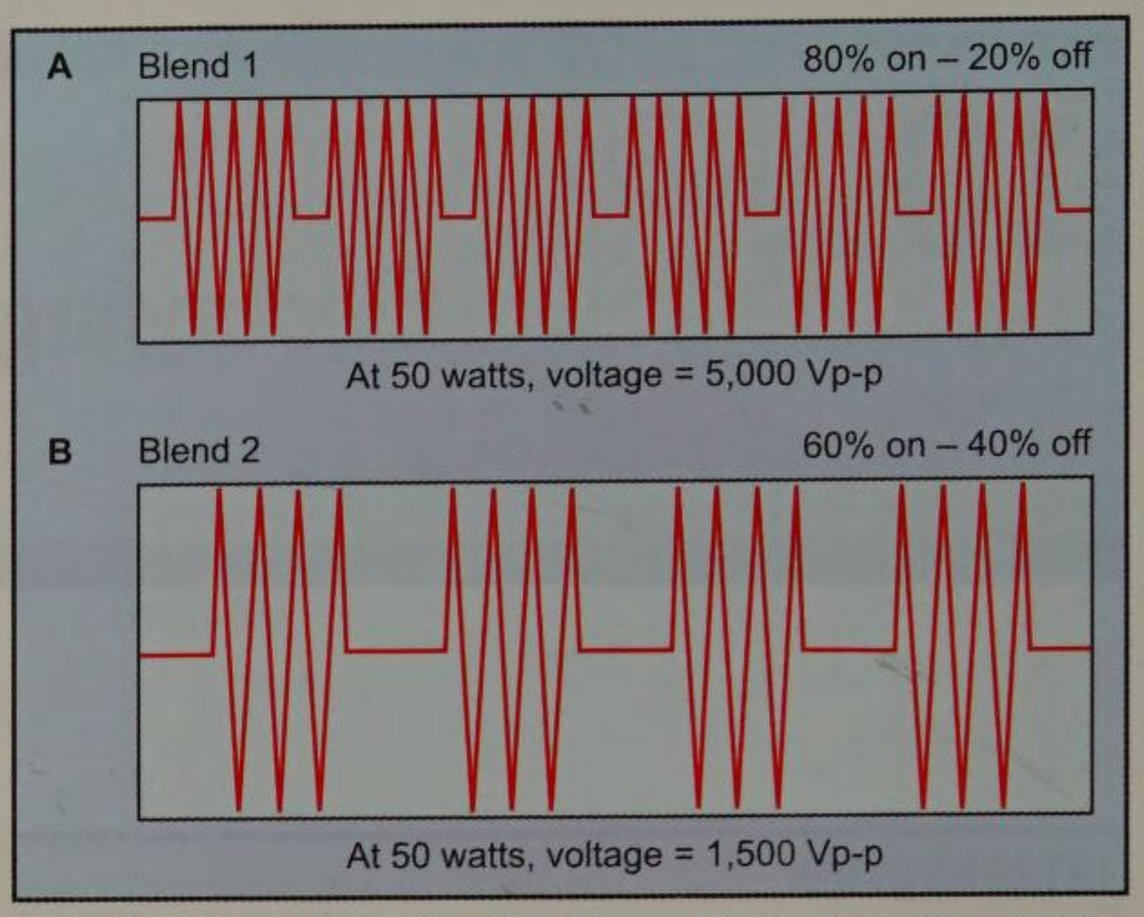


Fig. 10.3: Damped or COAG waveform

created by pushing bursts of electrons through the tissues. The cooling effect of the off time between bursts allows for the coagulation effect. Most generators provide a blended current, which does not result from combined Cut and Coag waveforms. The blended waveform interrupts the current at variable intervals, delivering variable degrees of coagulation and cutting properties (Figs 10.4A and B). The degree to which the blended mode cuts or coagulates depends on the relative time interval that the current flow is on or off. The tissue effects of electrosurgery depend on the various modes of delivering electric current.

Electricity is attraction of two oppositely charged particles, arbitrarily referred to as positive and negative. When an electrical connection is made between the two poles of positive and negative, an electrical current will flow between them.[2] Electrosurgical (ESU) units utilize AC current but at significantly faster rates of reversal for the polarity. ESU's utilize frequencies of around 350,000 to 500,000 times per second, or kilohertz (kHz).This extremely high frequency does not interfere with our own biological processes to any significant degree.



Figs 10.4A and B: Blend settings—These can vary as to the percentage of time the generator delivers the energy

As we all know that power is the product of Voltage and Current and when one chooses parameters to use an ESU, a choice of CUT or COAG is made, with the selection of power setting. The first basic electrical relationship is that of ***Power.*** The voltage and current may be oppositely varied and still deliver the same power output in watts. This is approximately the choice we make in choosing the 'Cut' versus 'Coag' modes on the ESU. 'Cut' accentuates the current aspects of the equation, and 'Coag' that of the voltage.

Here we cannot forget another common relationship i.e ***Ohm's law***—This states that Voltage is directly proportionate to current flowing through the equipment and voltage is product of current and resistance. The key point is that the resistance is not controlled by the operator but is a function of the tissue. The voltage drives or pushes the current through tissue against the tendency for tissue to resist this flow. As the flow is resisted, heat is generated in tissue. The use of 'Coag' with a monopolar instrument will allow for a higher 'driving force' through all the tissues between the instrument and the dispersive electrode, and increasing the probability of "stray energy" damaging unintended tissues somewhere outside the immediate target area. The higher 'driving force' also allows sparks to jump farther in air. This is seen with a long sparkling when fulgurating tissue in 'Coag mode.' This high voltage 'Coag' is the primary reason the current can jump through a surgical glove and zap the recipient. The hole seen in the glove is created by heat of spark. This also applies to the insulation

surrounding a monopolar instrument–particularly the disposable ones which have less insulation than reusable. The 'Cut' mode on an ESU accentuates the amperage aspects of the power setting. Its lower attendant voltages provide for better control over any 'stray' energy, and cause less margin damage on an incision.[3]

Current Density and Electrode Geometry (Figs 10.5 to 10.8)

The **current density** is defined as the amount of energy distributed over a certain contact area. This remains a most important parameter controlling the quality of an electrosurgical cut and the level of hemostasis achieved. The size of the electrode contact makes a drastic difference. The difference is created because of relatively small contact area. The electricity crowds together at this point of contact, resulting in a high power density and the intense thermal effect. The dispersive electrode collects the electricity over a wide surface contact area allowing a "dispersion" of the energy. This creates a low power density and totally eliminates any induced heating of tissue. The current is harmlessly dispersed over this electrode. If this pad were to pull away from the patient however, the surface contact area would get smaller and smaller, causing a "bottleneck" in the flow of electricity, increasing the power density, and resulting in a burn. Some units incorporate 'Failsafes' to sense this—many called *Return Electrode Monitors (REM) or Neutral Electrode Safety System (NESS).*

Fig. 10.5: Round loop electrode

Fig. 10.6: Needle electrode

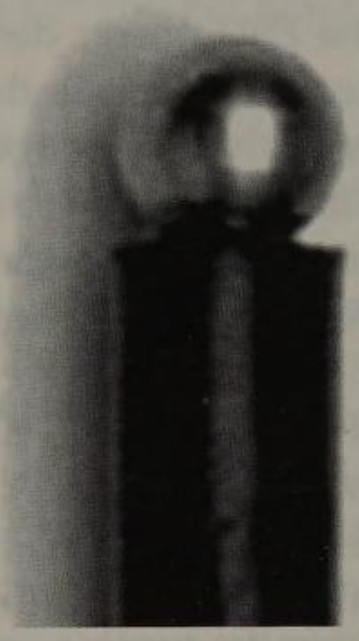


Fig. 10.7: Ball electrode

Fig. 10.8: Microneedle tip

Electrode Size

The choice of electrode size applies it to tissue, affects the cutting and hemostatic effect as much as or more so than the choice of 'Cut' and 'Coag' modes. **Fine wire loops** are used on rectoscopes for hysteroscopy or used as handheld loops cervical excisions. The finer the wire, the smaller the contact area with tissue, and the cleaner the cut. Finer wires do not require as high powers to drive them as do thicker wires, and infact overdriving fine wires with too much power will prematurely cause them to burn out. The correct technique of **loop electrode** is to activate the loop electrode just before touching tissue. The small contact area of the initial point of contact of contact allows clean cutting with high power density. This activation just before touching actually applies to most situations where clean cutting is desired.

In laparoscopy, the ESU power densities are varied by using different sizes and configurations of electrodes. A **hook electrode**, besides having a convenient geometry to handle tissue, has a moderate electrode size to allow hemostatic dissection. A **finer needle point electrode** will allow finer and cleaner incisions, but at some expense to hemostasis.

Ball electrodes will be good for electro-desiccation and fulguration of oozing tissue beds. A **spoon electrode**, when brushed against tissue with its narrow side, will allow clean dissection. By angling the spoon slightly so that more and more surface area is used, various degrees of hemostasis may be achieved while leaving the ESU in a "CUT" setting.

Monopolar Electrosurgery[1, 4]

Monopolar" or **"Unipolar"** refers to the surgical instrument having only one electrical contact surface, or electrode (Fig. 10.9). Instruments like monopolar graspers may still have two jaws but they are electrically the same surface or pole. Since electricity requires two electrodes in order to flow, the other electrode will some type of ground pad **or dispersive electrode** on the patient (Fig. 10.10A). Electricity will flow between the active electrode and dispersive electrode. Heating and tissue damage can theoretically occur anywhere between the active electrodes. As electrons, pushed with a given voltage, are concentrated in one specific location, heat within the tissue increases rapidly. The diathermy generator, an example of equipment using this principle, is familiar to most physicians. Electrons are passed through the body by applying two large metal conductors or plates on opposite sides of the body part to be heated.

Fig. 10.9: Electrode in monopolar electrosurgery

If either plate is markedly reduced is size, however, current density (and thus heat) is increased accordingly. Thus, a small, active electrode can create a burn (high current density) where the electrons enter the body. Also, the electrons that leave the body through a small return electrode can produce another burn. If tissue resistance

Fig. 10.10A: Ground electrode

Fig. 10.10B: Electrode for bipolar electrosurgery

is high but the corresponding voltage pressure is low, the current may cease to flow or may search out alternate pathways with lower resistance. Therefore, the operator should use the lowest voltage necessary to accomplish a given job and to ensure that the dispersive electrode is in good contact with the patient and broad enough to reduce current density far below the level of tissue destruction.

Monopolar is used for needle and hook electrode dissection in laparoscopy, loops and roller balls for hysteroscopy, fine wire loops for cervical excisions, and handheld scalpels (pens) for general surgical dissections.

Bipolar Electrosurgery[1,2]

"Bipolar" refers to both electrodes (Fig. 10.10B) being contained within the surgical instrument itself. The dispersive electrode (ground pad) is inactive or not used. This means that the flow of electricity is confined to only the space between the two surfaces of the instrument. New bipolar cutting instruments are changing the way bipolar has been used laparoscopically and hysteroscopically.

The bipolar system incorporates an active (efferent) electrode and a return (afferent) electrode into a two-poled instrument, such as forceps or scissors. This permits a discrete amount of desiccation confined primarily to the shape and size of the forceps in contact with the tissue and eliminates the chance of stray or alternate pathways for current flow that can occur with monopolar activation if the ground plate is improperly applied or if there is a break in the return lead.

Biological Effects of Electricity (Fig. 10.11)

The effect of electrosurgical instruments on tissue is due to heating in some form or another. Electrical principles are important to an understanding of how and where this heat may be created by the way it is delivered to an intended site, intensified and localized.

Electrosurgery may be used to cut (vaporize) and coagulate deeply (desiccate) or superficially (fulgurate). The tissue may be cut in a smooth, deliberate fashion without arcing, or it can be burned and charred.[2] Electricity can have different effects on tissue, dependent primarily on the frequency of the current. The "shocks" produce muscle contraction, pain, and potentially can stop a heart. These are all termed Faradic effects and are associated with the frequencies from about this 60 Hz up to 200-300 kHz. Frequencies higher than this do not

Fig. 10.11: Thermal effect on tissues

produce these types of biological effects. Sometimes faradic effects can be observed when using conventional ESU's, even though their frequencies are above this range. This is because the current can sometimes be "rectified" by biological tissue to lower Faradic frequencies. When Faradic effects are observed the procedure should be stopped. The actual surgical effects of electrosurgical cutting or coagulation are created by tissue heating though an ESU electrode is not itself "hot." The ESU causes a flow of electrons through the instruments and tissue – concentrated to small contact areas.[3]

Electrocoagulation may be carried out in different forms—from slow, delicate contact coagulation (desiccation) to the charring effects of the spray coagulation mode (fulguration), at times leading to carbonization. The temperature differences can vary from 45°C to more than 500°C.

Coagulation is a general term that includes both desiccation and fulguration. Sparking the tissue with fulguration always produces necrosis anywhere the sparks land. This is not surprising because each cycle of voltage produces a new spark, and each spark has an extremely high current density. In desiccation, the current is no more concentrated than the area of contact between the electrode and the tissue. As a result, desiccation may or may not produce necrosis, depending on the current density. For an equal level of current flow, fulguration is always more efficient at producing surface necrosis; however, the depth of tissue injury is superficial compared with contact desiccation because, with

fulguration, the sparks jump from one spot to another in a random fashion, and the energy is "sprayed" rather than concentrated. In general, fulguration requires only one fifth the average current flow of desiccation. The initial tissue resistance is low, and the resulting current is high, typically 0.5 to 0.8 amperes RMS. As the tissue dries out, its resistance rises until the electrical contact is broken. Because moist tissue is no longer touching the electrode, sparks jump to the nearest areas of moist tissue in fulguration mode, as long as the voltage is high enough to make a spark. Eventually, the resistance of desiccated tissue stops the flow of electrons, limiting the depth of coagulation.

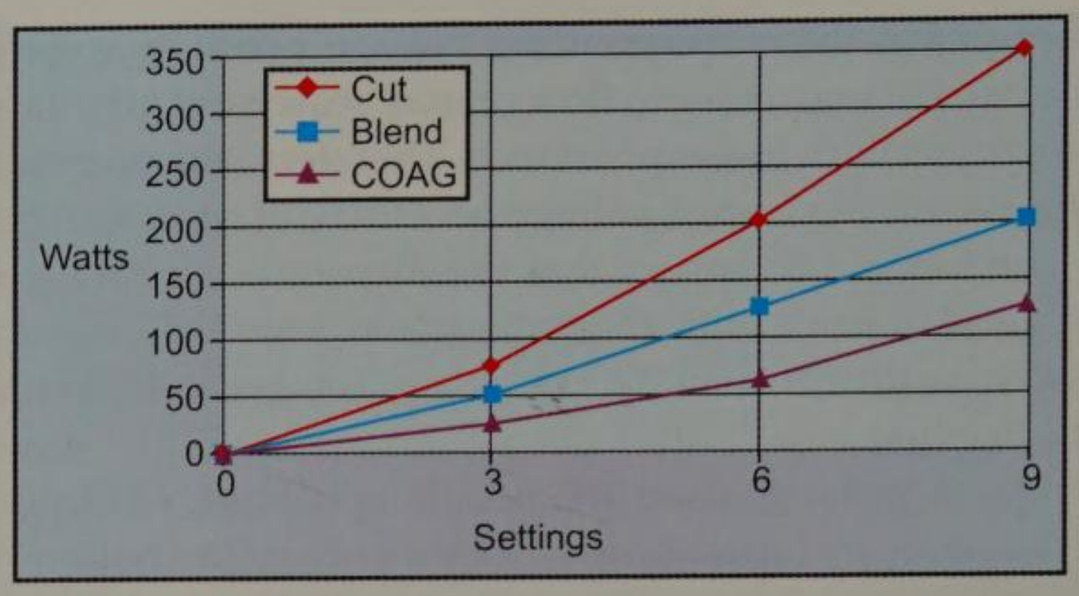


Fig. 10.12: Characteristics of monopolar power output curves

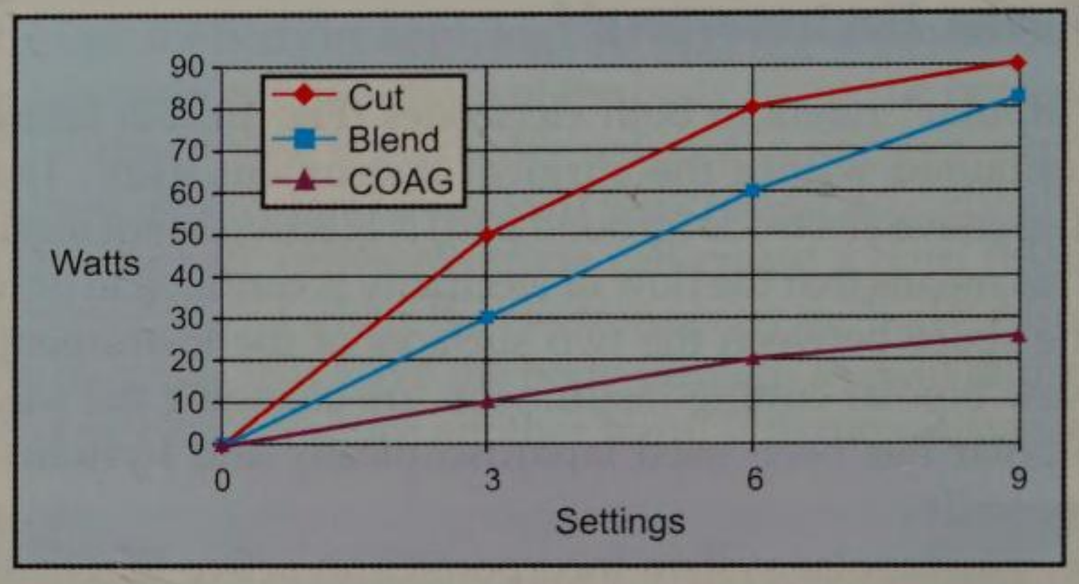


Fig. 10.13: Characteristics of bipolar power output curves

Generators

Significant differences exist among electrogenerators available for electrosurgical use. In general, generators that are set by a dial of numbers are calibrated to the peak voltage output rather than the power output, as is found in generators that have digital liquid crystals display window showing the output in watts. To determine the water output within the dial-a-number generators, the operator must refer to an output graph found in the manufacturer's manual; some generators have these output curves imprinted on the top of the generator box (Fig. 10.12). For unipolar use, most generators are calibrated against a 500-Ω load; for bipolar use, the load is usually set at 100 Ω (Fig. 10.13). Each generator has its own power output characteristics; the proper setting can be found with attention to the manual and experience. For general surgical use, most generators can produce a maximum of 8000 volts in the COAG mode. An 8000-volt pressure can push electrons 3 mm through room air under certain atmospheric conditions, which means that arcing to distant tissue is improbable; most of the time, they are used in the 1000 to 3000 volt range. The waveform frequency is set above 350,000 cycles/second to prevent muscle stimulation.

Desiccation Techniques

The most desiccation maneuver used in surgery is the coaptation of blood vessels. Captives (explain) coagulation involves clamping a bleeding vessel with a conductive clamp and applying a cutting or desiccating current to coagulate and promote a collagen weld of the vessel. To prevent unnecessary over-desiccation of surroundings tissue, the low-voltage, undamped waveform (CUT/desiccation) should be used. With monopolar energy, deep desiccation of the tissue in the grasp of the instrument, such as a hemostat, is uniform throughout the thickness of the tissue; but with bipolar energy, the output characteristics are such that the surface is heated first, leaving the centre of the tissue mass to be heated last. If the tissue is too thick, the bipolar current may cease to flow before deep desiccation is complete; thus, if the tissue coagulated is cut, it may bleed briskly.[1]

Desiccation is the safest way to obtain protein hemostasis, whether for clamping and "buzzing" a bleeder, or performing tubal sterilization. The technique is to firmly grasp the tissue with a large contact area electrode and using a straight "cut" mode. It may be applied to a vessel to stop bleeding, or to a larger structure like a fallopian tube.

Fulguration Techniques[1]

The fulguration or COAG waveform is frequently used at the wrong time and the wrong reasons. If an electrode is held off the surface of the tissue and the generator is activated, sparking to tissue occurs, sending each spark in a random fashion to char the surface only because the char acts as an insulator. Irrigating with a nonelectrolyte

solution or removing the blood from the bleeders using suction improves the task. For arterial vessels larger than 1 to 2 mm, fulguration is usually not effective and desiccation, staples, or ligatures are required.

Because the tissue effect of fulguration is due to the high power density of each spark, the effect of a single spark is probably the same, independent of voltage (at least within thé voltage range of current generators). Thus, during fulguration techniques, the higher output settings can be used with more efficiency, reducing the chance of touching the electrode to the tissue.[3]

Argon Beam Coagulator (ABC) for Controlled Fulguration (Fig. 10.14)

The argon beam coagulator is a monopolar electrode device that is housed inside a cannula through which argon has a dispelled at 12 L/min for open laparotomy and 4 L/minute for laparoscopy. The ionization properties of argon gas flowing over the electrode enhance the distance the spark can travel to complete the circuit to the tissue surface. Because the electrons prefer to stay in the stream of argon gas rather than pass through room air or CO_2, each having a higher resistance to electron flow, the collimation of the sparks leaves a more uniform surface coagulation effect. The gas, expelled under pressure, blows the pooled blood away from the surface bleeders, making coagulation more discrete and efficient. Flooding the field with glycine while fulgurating the tissue adds another dimension to efficient surface coagulation. Argon-enhanced electrosurgery incorporates a stream of argon gas to improve the surgical effectiveness of the electrosurgical current.

Fig. 10.14: Argon beam coagulator

The **advantages** of argon-enhanced electrosurgical cutting and coagulation are:

1. Decreased smoke, odor.
2. Noncontact in coagulation mode.
3. Decreased blood loss, rebleeding.
4. Decreased tissue damage.
5. Flexible eschar.

Argon gas offers very low electrical resistance to the sparking and this alters the nature of the fulgurative sparkling. Lower "coag" powers may be used to generate the sparks and it is more homogenous and uniform with gentle effect on tissue. The gas flow has the added effect of blowing blood away from the surface as the fulguration coagulates the surface. Since the gas will penetrate irregular surfaces the fulguration is more uniform even on an irregular surface.

Using the "coag" mode involves higher voltages and interrupted current delivery (dampened current). When using monopolar these higher voltages are present throughout the entire circuit. The chances of getting zapped through the glove increase. The chance of "stray current" causing unintended injury through downstream sparking or high current density burns increases (Fig. 10.15).

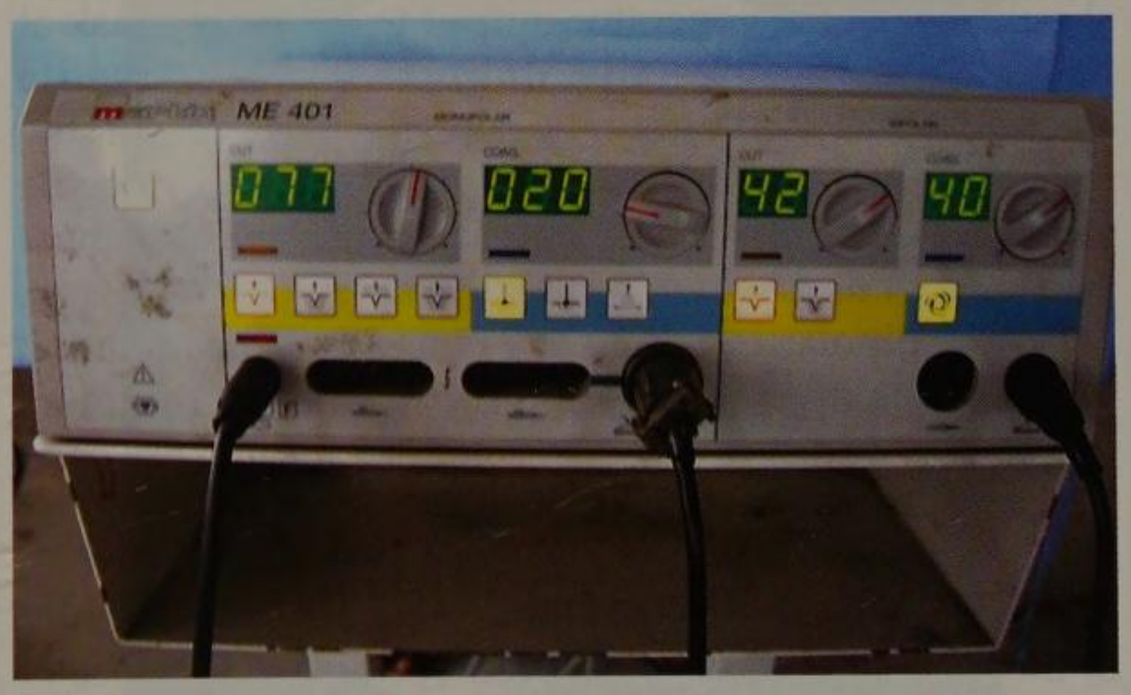


Fig. 10.15: Electrosurgical unit

Fig. 10.16: Foot paddles—Monopolar and bipolar

Principles of Electrosurgery in Laparoscopy

Because the tissue effect of electrophysics depends on the size and shape of each electrode, the chosen waveform and the power output, the challenge facing the laparoscopist is to properly match and mix the electrodes and generators. For instance, because of the difference in the power density of the forceps as they grasp the tissue, a 5 mm grasping forceps desiccates tissue much slower than a 3 mm forceps of similar design. A knife electrode can be used to incise tissue, yet when coagulation is needed, the surgeon can place the flat side of the electrode on the tissue, and with a CUT waveform, desiccate the tissue. Regardless of the waveform, a ball-shaped electrode desiccates when pressed against tissue, but if the surgeon holds the ball electrode away from an oozing surface and delivers a high voltage, coagulation waveform, the bleeding area can be fulgurated without deep tissue penetration.

As one electrode is changed to another, the surgeon should adjust the generator output to match the task at hand. This is especially important when needle electrodes are used after a blunter electrode. If not, the tissue touched by the high current density of the needle electrode can be severely damaged, and passive heat transfer can destroy the needle electrode.[5]

When bipolar instruments are used, if a coagulation waveform is used, a sticking phenomenon is common; in general, and undamped waveform should be used with bipolar instruments. When performing tubal sterilization with bipolar forceps, if using the coagulation or damped waveform for bipolar sterilization, the centre of the tube may not be destroyed because the surface of the tube is charred too quickly, rapidly increasing tissue impedance. Using an undamped waveform an in-line current flowmeter (ammeter) is a valuable accessory to ensure that all of the tissue between the forceps has been coagulated before the tissue is transected. For functioning of ESU food paddles are pressed according to the type of instruments (Monopolar or bipolar) required during the procedure (Fig. 10.16).

Smoke accumulation can occur if fulguration technique is used; for the most part, desiccation techniques create stream. It can be reduced or eliminated by irrigating the field to be coagulated with glycine rather than saline or lactated Ringer solution because the energy can be applied while irrigating. Nonelectrolytic fluids such as glycine (a nonelectrolytic solution with pH 6.1, similar to lactated Ringer solution) and sorbital (pH 5.2) can be used during surgical procedures to allow electrical energy to desiccate or fulgurate tissue. Blood does not mix well with these fluids, leaving a stream of blood easily seen in the nonelectrolytic fluid. Electricity seeks out the electrolytic-rich blood, and its ability to coagulate is enhanced because the energy is not dispersed, as it would be in an irrigation fluid, such as lactated Ringer solution.

If the surgeon floods the field as electrical energy is being delivered, the energy is not dissipated within the solution, as it is with electrolyte-rich fluids; and in a liquid media, smoke does not develop. At the end of the procedure, any intra-abdominal glycine is aspirated.[5]

Common Procedures where Electrosurgical Units Play Vital Role

1. Hysteroscopy.
2. Loop Electrode Excision Procedures.

Electrophysics Applied to Hysteroscopy[1]

Hysteroscopy means visualisation of the uterine cavity (womb) using a narrow telescope which is inserted via the vagina and cervix. The procedure can be done for diagnostic purposes (diagnostic hysteroscopy) but can also be used for therapy (operative hysteroscopy).[6]

With endometrial ablation, the resectoscope cutting loop and a roller electrode or a coagulating loop are used. Some surgeons shave the endometrial lining with the cutting loop electrode; others desiccate the endometrial lining with the roller ball or bar. The preference is to shave the endometrium first, use a pure, undamped waveform and drag the wire loop in a slow deliberate motion to 4 mm deep through the tissue, so there is some coagulation effect in addition to the cutting. The potential indications for diagnostic hysteroscopy are unexplained abnormal uterine bleeding, selected infertility cases and recurrent spontaneous abortion.

Electrosurgical desiccation is common method for hysteroscopic procedures. Adhesiolysis, division of a uterine septum, removal of endometrial polyps, resection of myomas, and endometrial destruction via resection, **electrosurgical desiccation**, or vaporization with the Nd:YAG laser can be performed. Hysteroscopy may also be used to remove foreign bodies or to position instruments in the fallopian tube.

Menorrhagia that does not respond to medications may be managed by endometrial ablation or resection. Ablation may be performed with the laser or by **electrosurgical desiccation** using a uterine resectoscope equipped with a blunt ball- or barrel-shaped electrode.[7]

Hysteroscopic Myomectomy[6]

Hysteroscopic myomectomy is a technique that can be performed only if the fibroids causing the symptoms are within or bulging into the uterine cavity (submucosal). This procedure is performed as outpatient surgery without any incisions. Anesthesia is needed because the surgery may take one to two hours and would otherwise be uncomfortable. A small telescope, the hysteroscope, is passed through the cervix, and the internal uterine cavity is seen. A camera is attached to the telescope, and the view is projected on a video monitor. This magnifies the picture and also allows the physician to perform the surgery while sitting in a comfortable position. The surgery can then proceed more rapidly.

Electricity passes through the thin wire attachment of the hysteroscope, allowing the instrument to cut through the fibroid like a hot knife through butter (Figs 10.17A and B). As the fibroid is shaved from within the uterine cavity, the heat from the instrument sears blood vessels so that the blood loss is usually minimal. Patients go home the same day, and recovery is remarkably fast, with most patients able to go back to normal activity in one or two days. Resectoscope myomectomy has been a major advance in the treatment modalities.

Endometrial Ablation (Figs 10.17B to D)

Endometrial ablation is an outpatient surgical procedure used to stop or decrease bleeding from the uterus. The traditional method of performing endometrial ablation uses electrical energy passed into the uterus at the end of a telescope in order to burn and destroy the lining of the uterus.[9, 10] The endometrial resection (TCRE), rollerball ablation and laser ablation are done under

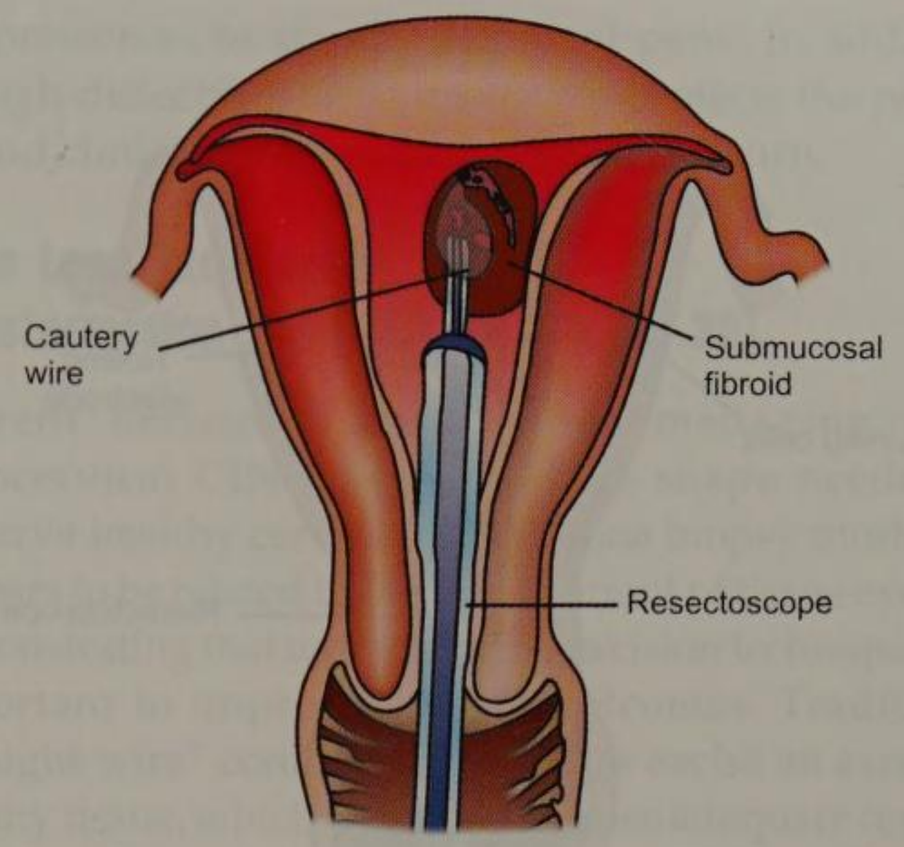


Fig. 10.17A: Myoma resection

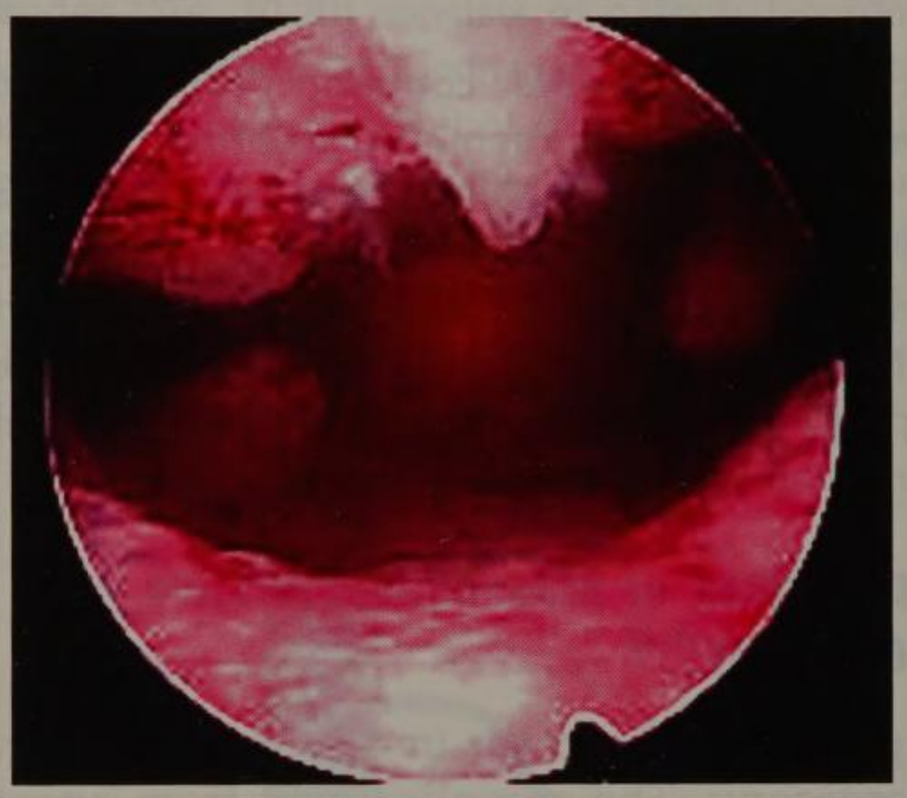


Fig. 10.17B: Before hydrothermal ablation

Fig. 10.17C: After hydrothermal ablation

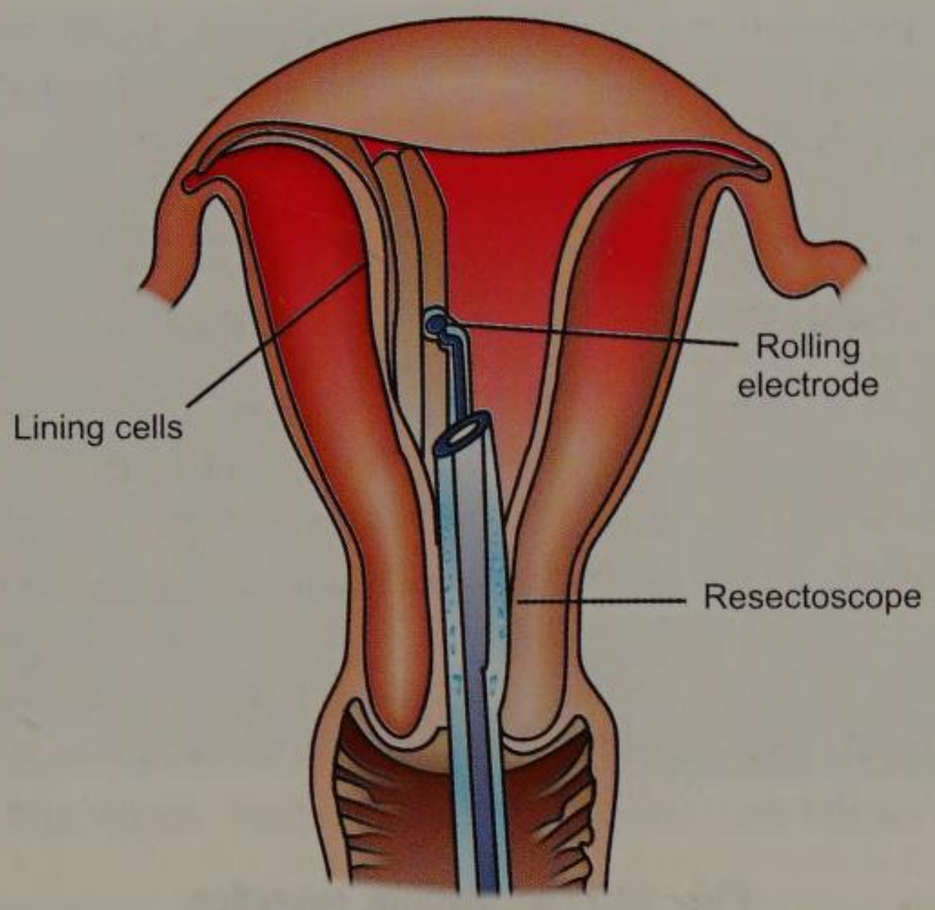


Fig. 10.17D: Ablation

direct vision, and other common problems such as endometrial polyps and submucous fibroids, can be dealt with at the same time. All ablation procedures can be done as day-case surgery, and under local anaesthesia if preferred.[6] Endometrial polyps are relatively common and benign in nature, especially in older women. If polyps are missed in dilatation and curettage, then the hysteroscopic polypectomy is preferred.

Complications of Diagnostic/Operative Hysteroscopy[11-13]

Complications may occur in diagnostic or operative hysteroscopy. The complications from operative hysteroscopy are more common and potentially more serious. They may result from anaesthesia, positioning, distension media, and surgery. If such complications occur during the procedure, surgery must be abandoned forthwith.

Loop Electrosurgical Excision Procedure (LEEP)

Electrophysics in LEEP

Loop electrosurgical excision is a valuable tool for the diagnosis and treatment of CIN. It has the advantage of being able to perform simultaneously a diagnostic and therapeutic operation during one outpatient visit.[15,16] The loop electrosurgical excision procedure (LEEP) is also used when Pap smear indicates the presence of abnormal cells on the surface of the cervix or there is cervical dysplasia.

LEEP uses a thin wire loop electrode which is attached to an electrosurgical generator. The generator transmits a painless electrical current that quickly cuts away the affected cervical tissue in the immediate area of the loop wire. This causes the abnormal cells to rapidly heat and burst, and separates the tissue as the loop wire moves through the cervix.

The tissue effect of electricity depends on the concentration of electrons (size of the wire), the power (watts), and the water content of the tissue. If low power or a large-diameter wire is used, the effect will be electrocautery and the thermal damage to tissue will be extensive. If the power is high (35-55 watts) and the wire loop is small (0.5 mm), the effect will be electrosurgical and the tissue will have little thermal damage. The actual cutting is a result of a steam envelope developing at the interface between the wire loop and the water laden tissue. This envelope is then pushed through the tissue, and the combination of electron flow and acoustical events separates the tissue. Following the excision, a 5 mm diameter ball electrode is used and the power is set at 50 watts. The ball is placed near the surface so a spark occurs between the ball and the tissue. This process is called electrofulguration, and it results in some thermal damage that leads to hemostasis. If too much fulguration occurs, the patient will develop an eschar with more discharge and the risk of infection and late bleeding will be higher.

Loop excision should not be used prior to identification of an intraepithelial lesion that requires treatment. The entire transformation zone will be removed along with varying amounts of the cervical canal, thus potentially comprising fertility. This is particularly true of young women, who may have large, immature transformation zones with extensive acetowhite areas. This technique allows the gynecologist to send the excised tissue to the lab for further evaluation which insures that the lesion was completely removed, as well as allowing for a more accurate assessment of the abnormal area.

LEEP Electrodes (Figs 10.18 and 10.19)

1. Loop electrodes have the patented Safe-T-gauge which allows the gynecologist to set the maximum depth of excision, preventing excessive excising of tissue and provides support to the loop wire for greater strength and stability.
2. All loop and needle electrodes utilize high-grade tungsten wire. Because it retains its mechanical

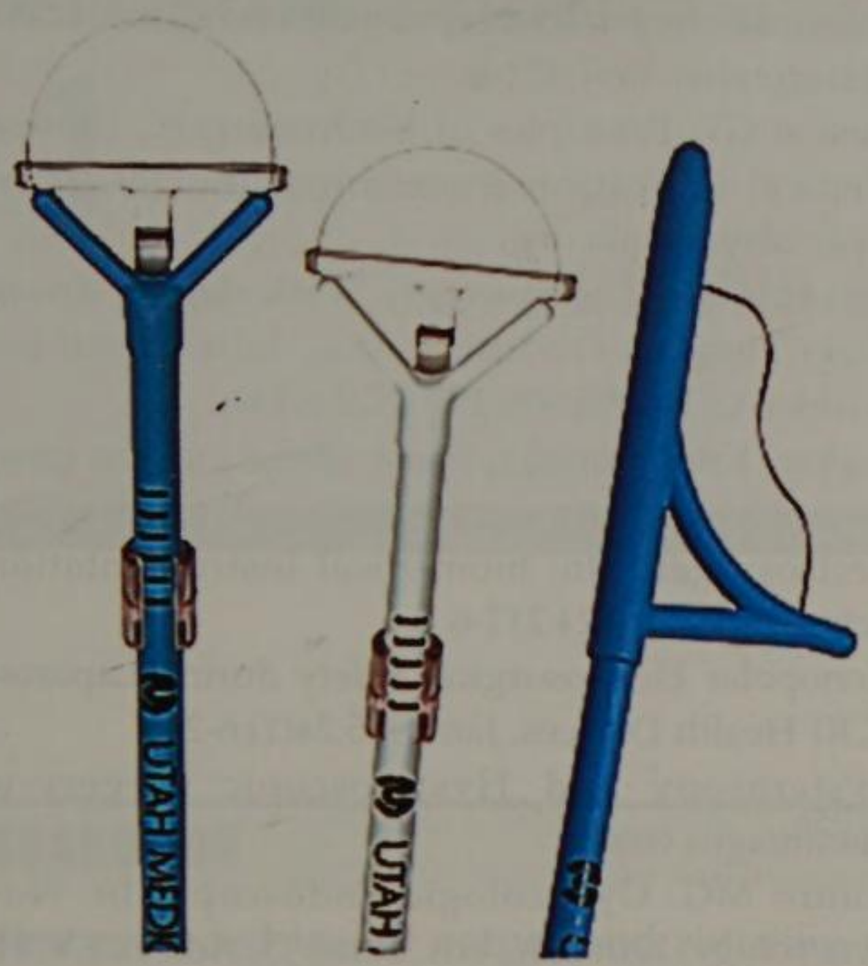


Fig. 10.18: LEEP electrodes

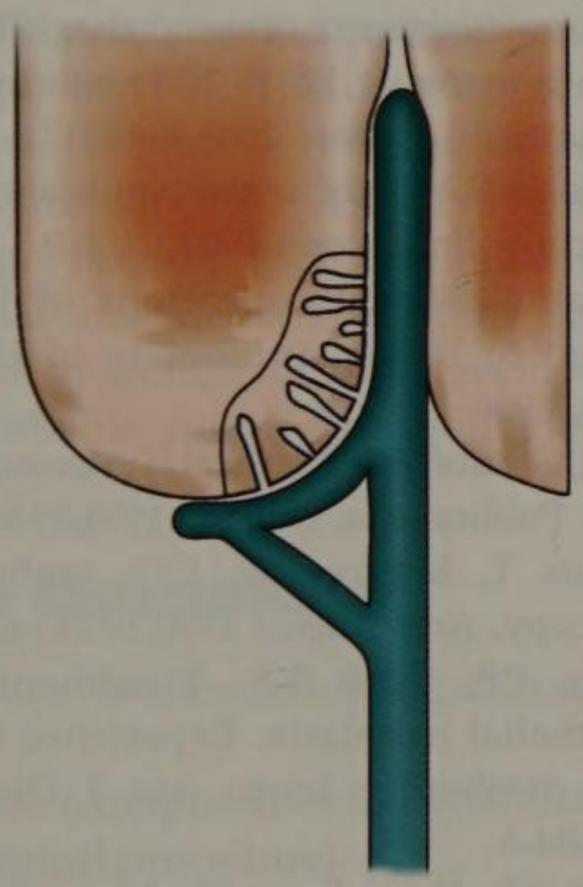


Fig. 10.19: Electrode in position

properties at a higher temperature than stainless steel, tungsten maintains better shape and wire integrity throughout the excision procedure.

3. Color coded for ease in identification
4. Single-use and disposable, preventing cross-contamination and ensuring consistent performance on every procedure.
5. The electrodes all utilize the industry standard 3/32" diameter stainless steel shaft which allows easy connection to standard control pens. In addition, high-dielectric plastic insulation protects the patient and clinician from electric shock and burn.

Large Loop Excision of Transformation Zone (LLETZ) (Fig. 10.20)

Current excisional devices for managing deep endocervical CIN lesions lack the shape needed to preserve healthy cervical tissue. Cone biopsy morbidity appears to be related to the total amount of tissue excised, demonstrating that tissue-sparing excision techniques are important to improve clinical outcomes. Traditional "straight-wire" conization electrodes excise an excess of healthy tissue, which may compromise adequate cervical function. Research has also shown that CIN involvement in most endocervical glands extends no more than 3.8 mm from the cervical surface. The **LLETZ conization electrodes** (Fig. 10.20) consists of patented contoured *electrode shape,* removes a constant thickness specimen to ensure adequate removal of diseased tissue without risking excessive excision of healthy cervical tissue. It potentially reduces the possibility of cervical stenosis, reduces recurrence and/or progression rates and provides simultaneous hemostasis compared to cold knife conization.

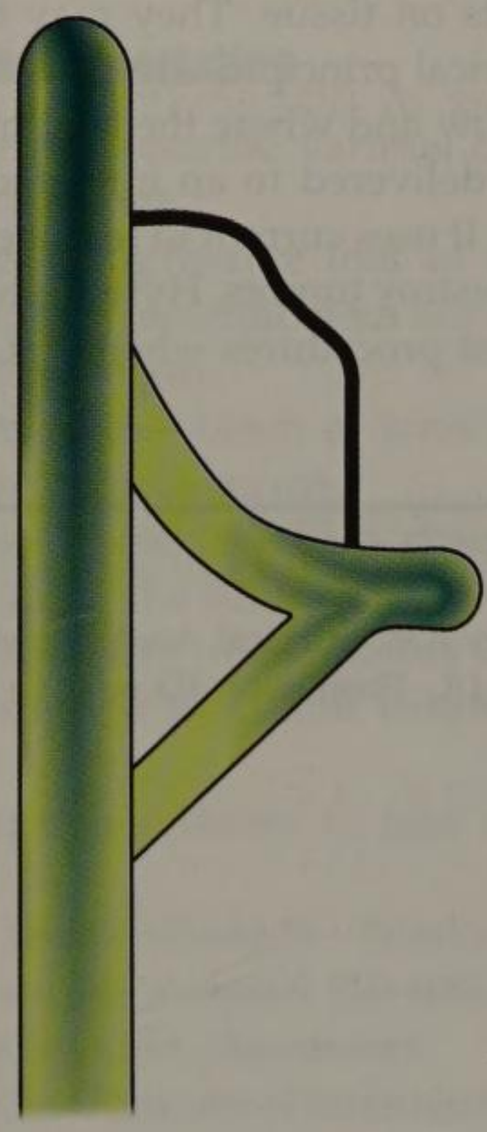


Fig. 10.20: LLETZ conization electrode

Recommendations to Avoid Electrosurgical Patient Complications

Most potential problems can be avoided by following these simple guidelines:

1. Inspect insulation carefully.
2. Use lowest possible power setting .
3. Use a low voltage waveform (CUT).
4. Use brief intermittent activation vs prolonged activation.
5. Do not activate in open circuit.
6. Do not activate in close proximity or direct contact with another instrument.
7. Use bipolar electrosurgery when appropriate.
8. Select an all metal cannula system as the safest choice. Do not use hybrid cannula systems that mix metal with plastic.
9. Utilize available technology, such as a tissue response generator to reduce capacitive coupling or an active electrode monitoring system, to eliminate concerns about insulation failure and capacitive coupling.

CONCLUSIONS

Modern Electrosurgical Units (ESU) utilize either monopolar or bipolar electrosurgical elements. This involves an electrical current flow through tissue to generate the heating effects on tissue. They may be monopolar or bipolar. Electrical principles are important to an understanding of how and where the heat may be created by the way it is delivered to an intended site, intensified and localized. It uses current to remove tissue, coagulate bleeding, or destroy tumors. Hysteroscopy and LEEP are the commonest procedures where ESU; have definitive role.

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11

Sutures and Suturing Techniques

Nitin Agarwal, Anshul Grover, Neerja Goel

INTRODUCTION

The first recorded use of suture and suturing method dates to the 16th century BC in the Edwin Smith papyrus[1], the oldest record of a surgical procedure. Over the centuries, many different materials have been used as sutures. The first specific suture was brought in by Lord Joseph Listere's catgut in 1860[2] and disinfected chromic catgut in 1881. The development of modern suture material began in 1931 with production of absorbable synthetic fibre. The 'Polyenterephthalate ester' called polyester in 1950 was introduced as high-grade material and at the same time sterilization of surgical suture by irradiation was developed. In 1970-71 the first absorbable suture from polyglcolic acid was synthesized.[1]

Ideal Suture Characteristics

The ideal suture[3] has the following characteristics:

1. Sterile.
2. All-purpose (composed of material that can be used in any surgical procedure).
3. Causes minimal tissues injury to tissue reaction (i.e. nonelectrolyte, noncapillary, nonallergic, noncarcinogenic).
4. Easy to handle.
5. Holds securely when knotted (i.e., no fraying or cutting).
6. High tensile strength.
7. Favorable absorption profile .
8. Resistant to infection.

Obviously there is no single suture material, which can fulfill all these criteria. In different situations and with difference in tissue composition throughout the body the requirement for adequate wound closure require different suture characteristics.

Essential Suture Characteristics

All sutures should be manufactured to assure fundamental characteristics as follows:

1. Sterility.
2. Uniform diameter and size.
3. Pliability for ease of handling and knot security.
4. Uniform tensile strength by suture type and size.
5. Freedom from irritants or impurities that would elicit tissue reaction.

Other Suture Characteristics

The following terms describe various characteristics related to suture material:

1. Absorbable—Progressive loss of mass and/or volume of suture material; does not correlate with initial tensile strength.
2. Breaking strength—Limit of tensile strength at which suture failures occurs.
3. Capillarity—Extent to which absorbed fluid is transferred along the suture.
4. Elasticity—Measure of the ability of material to regain its original from and length after deformation.
5. Fluid absorption—Ability to take up fluid after immersion.
6. Knot—pull tensile strength—Breaking strength of unknotted suture material (10-40% weaker after deformation by knot placement).
7. Knot strength—Amount of force necessary to cause a knot to slip (related to the coefficient of static friction and plasticity of a given material.

8. Memory—Inherent capability of suture to return to or maintain its original gross shape (related to elasticity, plasticity and diameter).
9. Plasticity—Measure of the ability to deform without breaking and to maintain a new form after relief to the deforming force.
10. Pliability—Ease of handling of suture material; ability to adjust knot tension and to secure knots (related to suture material, filament type and diameter).
11. Straight—pull tensile strength—Linear breaking strength of suture material.
12. Suture pullout value—The application of force to a loop of suture located where tissue failure occurs, which measures the strength of a popular tissue; variable depending on anatomic site and histological composition (fat, 0.2 kg; muscle, 1.27 kg; skin 1.82 kg; fascia, 3.77 kg).
13. Tensile strength – Measure of a material or tissue's ability to resist deformation and breakage.
14. Wound breaking strength—Limit of tensile strength of a healing wound at which separation of the wound edges occur.

Suture Size

The United State Pharmacopoeia (USP) was established in 1937 for standardization and comparison of suture materials, corresponding to metric measures and absorption by body tissues.[4]

Sutures are divided into size categories based on diameter as defined by the USP. Sutures progressively larger than 0 are numbered in increasing numerical order, that is, 1, 2, 3 etc., size progressively smaller than 0 are indicated by an increasing number of zeros; that is 0,00,000. The smaller the suture, the more zeros. For simplicity, the smaller numbers often are written numerically as 1-0, 2-0, etc., where the first numeral refers to the number of zeros.

Suture materials[5] are generally categorized by three characteristics:

1. Absorbable vs non-absorbable.
2. Natural vs synthetic.
3. Monofilament vs multifilament.

Absorbable Sutures

Absorbable sutures lose the majority of their tensile strength before 60 days when implanted in the body. They provide temporary wound support, until the wound heals well enough to withstand normal stress. Absorbable sutures are further divided by the USP into natural and synthetic. Absorption occurs via inflammatory reaction by utilizing tissue enzymes in natural sutures and by hydrolysis in synthetic materials. Hydrolysis causes less tissue reaction than enzymatic degradation.

The first stage of absorption has a linear rate, lasting for several days to weeks. The second stage is characterized by loss of suture mass and overlaps the first stage. Loss of suture mass occurs as a result of leukocytic cellular responses that remove cellular debris and suture material from the line of tissue approximation. Chemical treatments, such as chromic salts, lengthen the absorption time. Loss of tensile strength the rate of absorption are different phenomena. Accelerated absorption may occur in patients with fever, infection, hypoproteinemia and fluid filled moist cavities and may lead to loss of tensile strength also. Absorbable sutures are listed in Table 11.1.

Non-absorbable Sutures

Non-absorbable sutures are defined as sutures that maintain the majority of their tensile strength for more than 60 days in body tissue. They elicit a tissue reaction that results in encapsulation of the suture material by fibroblasts. These are commonly used in percutaneous skin closure and are removed after sufficient healing has occurred. Healing typically occurs in 6-8 days in an otherwise healthy patient. Non-absorbable sutures also have internal use; in these situations, the sutures become permanently encapsulated in tissue. These sutures are classified by the USP into three classes:

Class 1—Silk or synthetic fibres monofilament, twisted, or braided construction.

Class 2—Cotton or linen fibres or coated natural or synthetic fibres in which the coating contributes to suture thickness without adding strength.

Class 3—Metal wire to monofilament construction.
Non-absorbable sutures are listed in Table 11.1.

Monofilament Versus Multifilament Sutures

Monofilament suture is made of a single strand. This structure is relatively more resistant to harboring micro-organisms and ties relatively more easily when compared

Table 11.1: Classification of absorbable and non-absorbable sutures

Absorbable sutures	*Non-absorbable sutures*
Natural	**Natural**
Catgut	Silk
Chromic	Cotton or linen
	Metal wire
Synthetic	**Synthetic**
Monocryl (monofilament)	Nylon (monofilament)
PDS (monofilament)	Prolene (monofilament)
	Metal wire

with multifilament sutures. Less resistance to passage through tissue occurs than with multifilament suture. Great care must be taken in handling and tying monofilament suture because crushing or crumping of this suture can nick or weaken the suture and leads to undesirable and premature suture failure.

Multifilament suture is composed of several filaments twisted or braided together. These materials are less stiff but have a higher coefficient of friction. Multifilament suture generally has greater tensile strength and better pliability and flexibility than monofilament suture. This type of suture handles and ties well. Because multifilament materials have increased capillarity, the increased absorption of fluid may attract or the introduction of pathogens.

Absorbable Suture

Natural

Collagen: This comes from the submucosa of sheep intestine or serosa of beef intestine.

Plain catgut: This is one of the oldest sutures. Unlike the name it is obtained from the submucosa of sheep's intestines. As it is a foreign protein, it elicits marked inflammatory response in tissue and is rapidly degraded by proteolytic enzymes. Tensile strength is maintained for 7-10 days and its absorption is complete in 70 days. It is used in rapidly healing tissues e.g. ligation of superficial vessels near bladder in vaginal surgery, subcutaneous fatty tissue and during Pomeroy tubal ligations.

Chromic catgut: Chromic catgut is prepared by treating plain catgut with chromic acid salts that bind to the antigen sites in the collagen. It maintains more than half of its tensile strength at 7-10 days, with some of the measurable strength up to 21 days. It is used where long-term strength is not needed. It is used during closure of peritoneum and vaginal edges. It should not be used to suture skin because of inflammatory response can cause scarring. It is also avoided in infected tissue as inflammatory cells produce proteolytic enzymes and the suture is degraded (Fig. 11.1).

Synthetic

Chemical polymers absorbed by hydrolysis and cause a lesser degree of tissue reaction following placement.

Polyglactin 910 (Vicryl) and polyglycolic acid (Dexon II): This suture is multifilament braded suture coated with a copolymer of lactide and glycolide (polyglactin 370).[6] The water—repelling quality of lactide slows loss of tensile strength and the bulkiness of lactide leads to rapid absorption of suture mass once tensile strength is lost. The suture is also coated with calcium stearate, which permits easy tissue passage, precise knot placement and smooth tie-down. Tensile strength is approximately 65% at 14 days, 20-30% at 21 days and no strength at 28 days postimplantation. The initial strength is also greater than catgut of equal size. It is used in general soft tissue approximation and has replaced all the uses of chromic catgut. They have a special use in facial closure where facial dehiscence is expected due to presence of infection. Another similar suture material is made from polyglycolic acid coated with polycaprolate (Dexon II). This material has a similar tensile strength and absorption profile (Fig. 11.2).

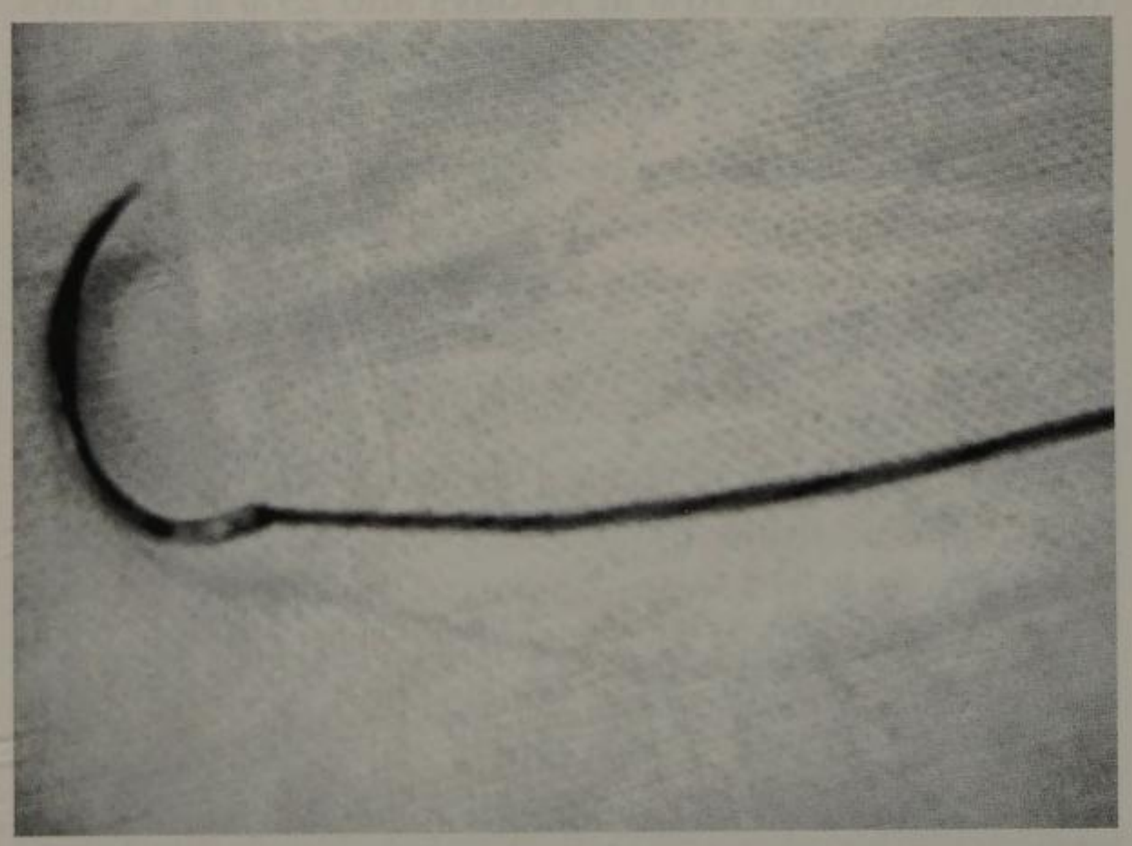

Fig. 11.1: Chromic catgut no. 1 on curved cutting needle

Fig. 11.2: Vicryl no. 0 on half circle round body needle

Polyglactin 910 Rapide (Vicryl rapide): It is identical in structure in chemical structure but is of low molecular weight. It is a braided suture and is absorbed like plain catgut. It is used for superficial soft tissue and skin. It produces minimal inflammatory response. It is very useful for episiotomy closure where the suture falls of on 7th day after complete healing and if any remains of suture are present they can be wiped off. Although it does not meet the USP strength requirement for synthetic absorbable suture, its tensile strength exceeds the natural collagen suture of similar size.[6]

Polydioxanone (PDS II): This is polyester monofilament suture made of p-dioxanone. This suture provides extended wound support with slight tissue reaction. Tensile strength is 70% at 14 days and 25% at 42 days. Wound support remains up to 6 weeks. Absorption is minimal for the first 90 days and essentially complete within 6 months. It has a low affinity to micro organisms due to lack of interstices that could serve as nidus for infection. Being single fibre, this suture can be damaged inadvertently by instruments, needles or other sharp-edged material where it can be cut, entangled or break.[7]

Policaprone 25 (Monocryl): This synthetic suture is a monofilament suture that is a copolymer of glycolide and e-caprolactone. The suture has superior pliability, leading to ease of handling and tying. Its absorption time is similar to chromic catgut having a highly uniform and predictable pattern of absorption. It retains approximately 50% to 60% tensile strength at 7 days, 20% to 30% at 14 days and none at 21 days, it is used for subcuticular closure and soft tissue approximation (bladder buttressing, peritoneal closure or small vessel ligation). It is not indicated in fascial closure or where approximation under stress is required (Fig. 11.3).

Nonabsorbable Sutures

By definition nonabsorbable sutures are resistant to the action of living mammalian tissue. Over time, these sutures also lose tensile strength and the natural fibres are eventually completely absorbed or digested. Advantage of these are maintenance of tensile strength for long period of time and disadvantages of non-absorbable sutures include the potentially suture related pain, palpable sutures and occasionally formation of scar tissue.

Natural

Surgical silk: Modern natural nonabsorbable suture is surgical silk, which is made of raw silk spun by silkworms. The suture may be coated with beeswax or silicone. It is one of the best handling sutures. It provides excellent knot security. It is degraded by proteolysis and is often undetected by 2 years at the site of placement. Tensile strength decreases with moisture absorption and is lost by 1 year. The problem with silk suture is the acute inflammatory reaction triggered by this material. Host reaction leads to encapsulation by fibrous connective tissue. Due to its multifilament nature and the capillary action of this suture, make it unsuitable in contaminated tissue (Fig. 11.4).

Surgical cotton: This is made up of twisted long, staple cotton fibres. Tensile strength is 50% in 6 months and

Fig. 11.3: Monocryl no. 0 on half circle round body needle

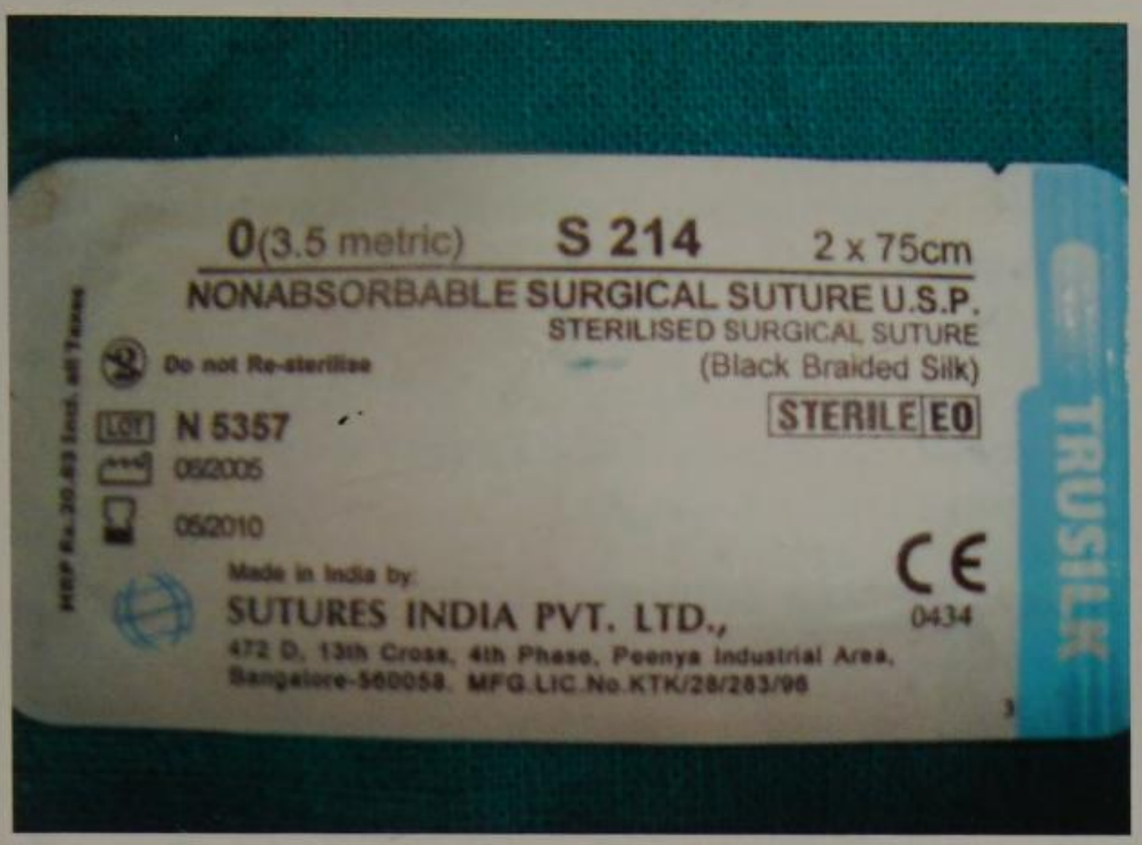

Fig. 11.4: Braided black silk no. 0

30% - 40% by 2 years. Surgical cotton is nonabsorbable and becomes encapsulated within body tissues.

Surgical steel: This is made up of stainless steel (iron-chromium–nickel–molybdenum aloy) as a monofilament or twisted multifilament. It can be made with flexibility fine size and the absence of toxic elements. These are difficult to handle and tend to puncture gloves and tissues. Once upon a time these were sued to repair vesico-vaginal fistulae. Surgical steel demonstrates high tensile strength with little loss over time and low tissue reactivity. The material also holds knots well. It can be sued in tough tissues and abdominal wall closure. In vaginal surgery the use is very limited.

Synthetic

Nylon: Polymide polymer suture material available in monofilament and braided the elasticity of this material makes it useful in retention and skin closure. Nylon is quite pliable especially when moist. The braided forms are coated with silicone. Nylon suture has good handling characteristics although its memory tends to return to the material to its original strength form. Nylon has 81% tensile strength at 1 year, 72% at 2 years and 66% at 11 years. It is stronger than silk, elicits minimal acute inflammatory reaction. It is hydrolysed slowly but remaining suture material is stable at 2 years, due to gradual encapsulation by fibrous connective tissue. Its disadvantage includes difficulty in achieving good knot security. The 4-5 throws (knots) are required to achieve a secure knot.

Polypropylene (Prolene)

This monofilament suture is an isostatic crystalline stereo-isomer of a linear propylene polymer, permitting little or no saturation. The material does not adhere to tissue and is useful as a pull out suture (subarticular closure). It holds knots better than other monofilament synthetic materials. It is biologically inert and elicits minimal tissue reaction. Prolene is not subject to degradation or weakening and maintains tensile strength for up to 2 years. This material is useful in contaminated and infected wounds, minimizing later sinus formation and suture extrusion (Fig. 11.5).

Suture Selection

Certain general principles[8] can be applied to suture selection:

1. The surgeon selects the smallest suture that adequately holds the healing wound edges. The tensile strength of the suture never exceeds the tensile strength of tissues.
2. As the wound heals—relative loss of suture strength over time should be slower than the gain of tissue tensile strength. Therefore, nonabsorbable sutures are used in skin, fossa and tendons (slow healing tissues), absorbable sutures for mucosal wounds—rapidly healing tissues (e.g. vaginal mucosa).
3. Aesthetic concerns in region of head and neck, eyelid, periorbital area, nose, pinna, vulva, lip and vermillion. In these cases tensile strength required is less—smaller suture size are preferred

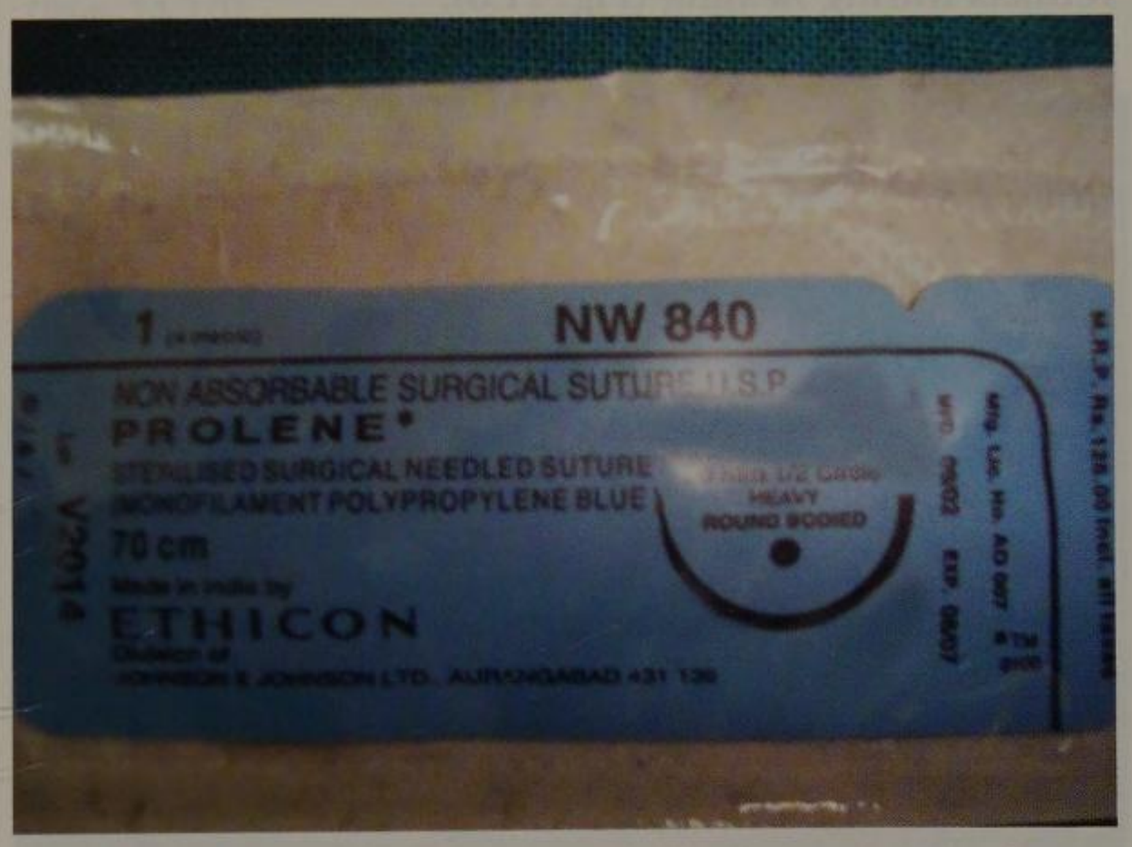

Fig. 11.5: Prolene no. 1 on half circle round body

4. Activity and mobilizing of face, anterior and posterior near scalp require high tensile strength.
5. Presence of foreign body in contaminated tissue facilitate infection. Use monofilament suture of smaller size—nylon, prolene.

SUTURING TECHNIQUES IN CLINICAL PRACTICE

The goals for suturing[9,10] include:
1. Closing dead space.
2. Supporting and strengthening wounds until healing
3. Approxoimating skin edges for aesthetic purpose.
4. Minimizing the risks of bleeding and infection

Many varieties of suture materials and needles are available to the gynecologic surgeon. The choice of sutures and needles is determined by the location of the lesion, the thickness of the tissue in that location and the amount of tension exerted on the wound. The various suturing techniques are described below:

APPROXIMATION OF CUT EDGES[9,10]

Simple Interrupted Sutures

Technique

The suture is placed by inserting the needle perpendicular to the tissue, traversing the full thickness of the tissue and exiting perpendicular to the tissue on the opposite side of the wound. In general the suture should have a flask shaped configuration—the stitch should be wider at the base. This maneuver decreases the likelihood of creating a depressed scar as the wound retracts during healing (Fig. 11.6).

Advantages
1. Easy to place.
2. Have greater tensile strength.
3. Less potential for causing wound edema and impaired cutaneous circulation.

Disadvantages
1. Increased length of time required for placement.
2. Greater risk of cross hatched marks across suture lines when placed on skin.

Simple Running Sutures

Technique

It is an uninterrupted series of simple interrupted sutures. A series of simple sutures are placed in succession without tying or cutting the suture material after each part. They are used for long wounds in which wound tension has been minimized by prior deep sutures, in which wound approximation is good (Fig. 11.7).

Advantages
1. Quicker placement.
2. Rapid approximation of wounds.

Disadvantages
1. Risk of dehiscence if suture material ruptures.
2. Difficulty in making fine adjustments of alignments along suture line.
3. Puckering of stitches if placed in thin skin.

Running Locked Sutures

Technique

The traditional running suture is locked by passing the needle through the loop preceding it as each stitch is placed (Fig. 11.8).

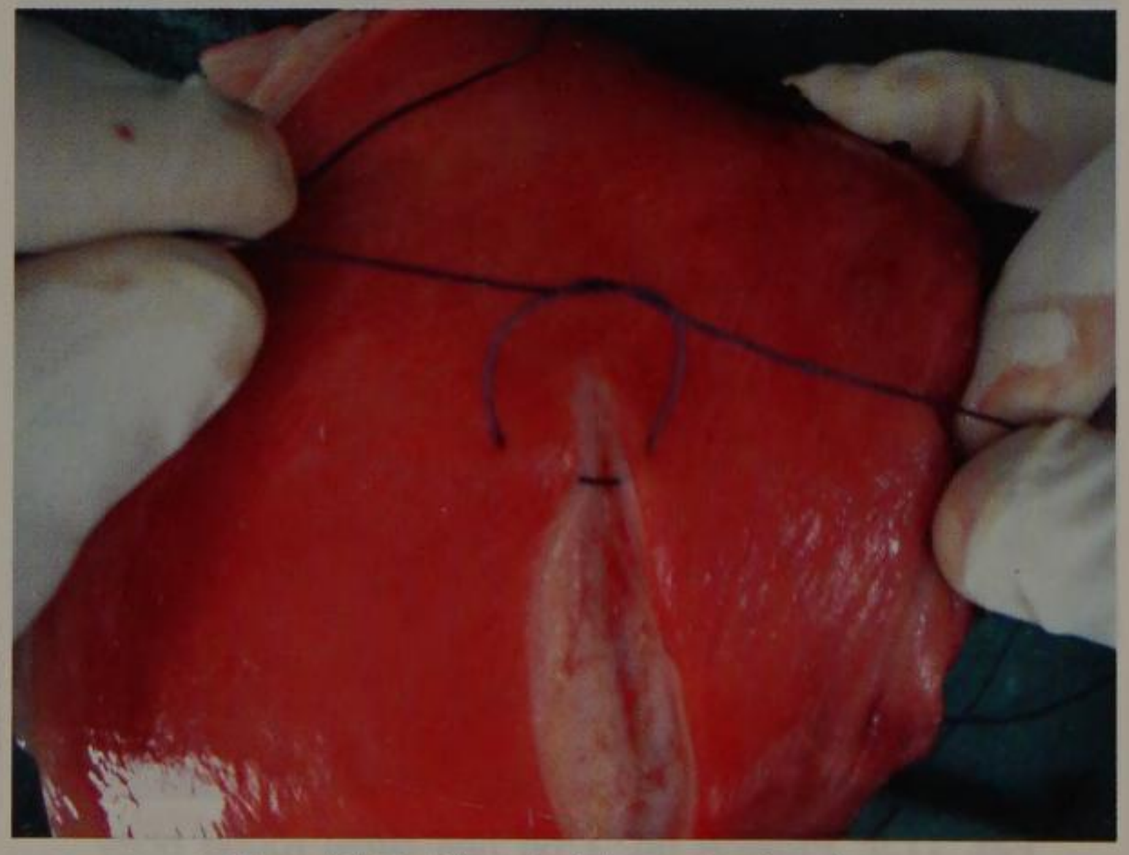

Fig. 11.6: Simple interrupted suture

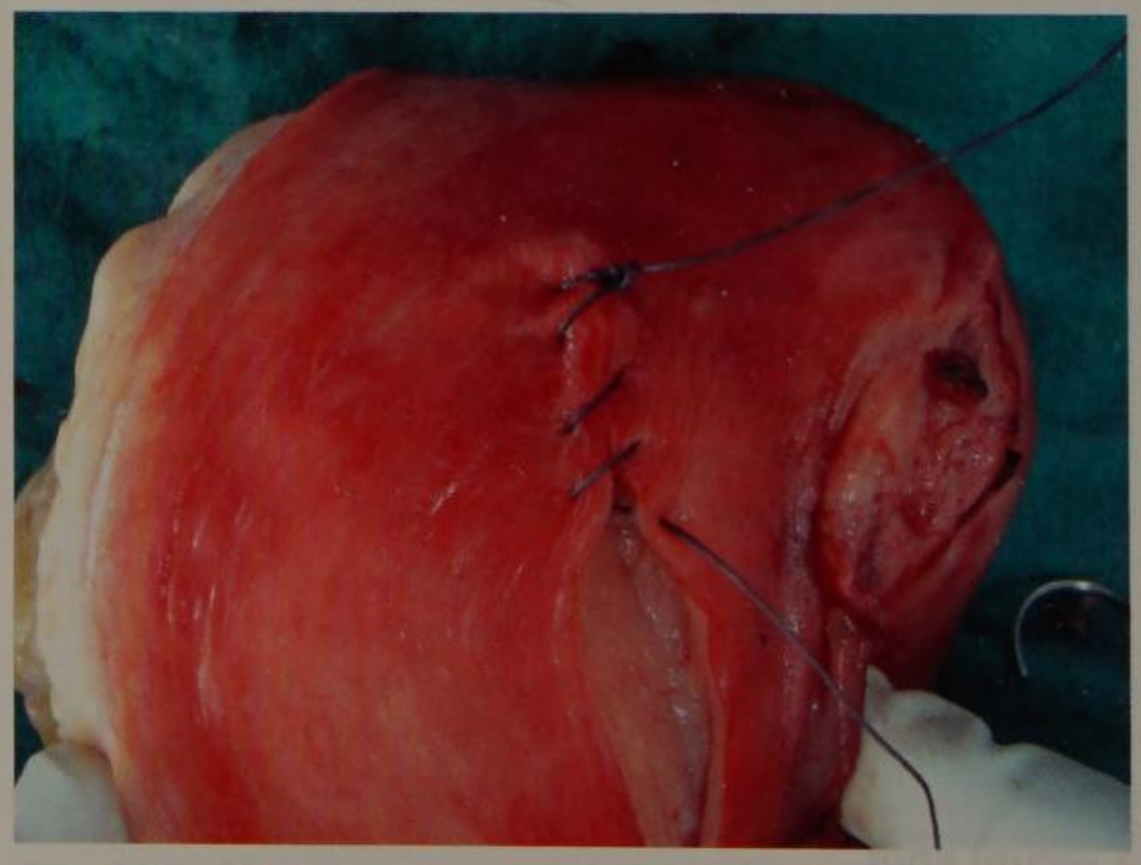

Fig. 11.7: Simple running suture

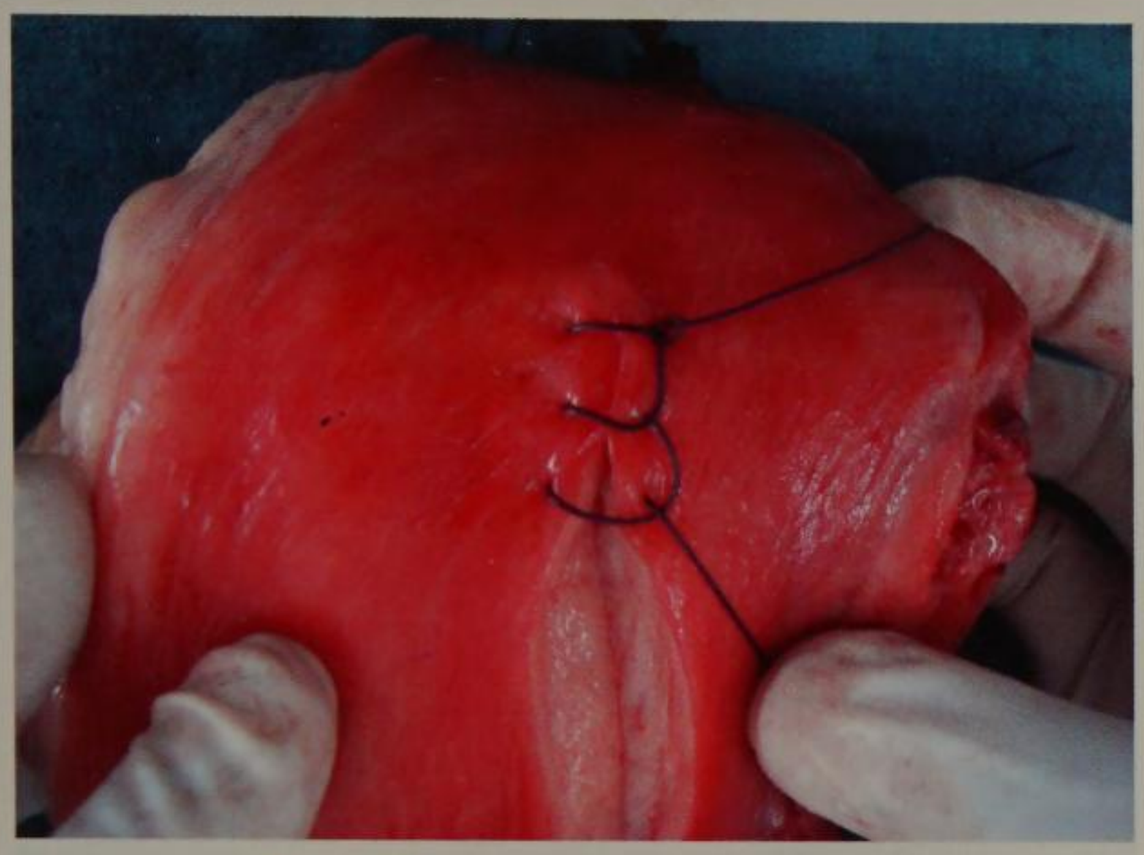

Fig. 11.8: Running locked suture

Advantages

1. Increased tensile strength.
2. Useful in wounds under moderate tension or indoors requiring additional hemostasis because of oozing from the skin edges.

Disadvantages

1. Increased risk of impairing microcirculation surrounding the wound.
2. Can cause tissue strangulation if placed too tightly.

Vertical Mattress Sutures

Technique

It consists of a simple interrupted stitch placed wide and deep into the wound edge and a second more superficial interrupted stitch placed closer to the wound edge in the opposite direction (Fig. 11.9).

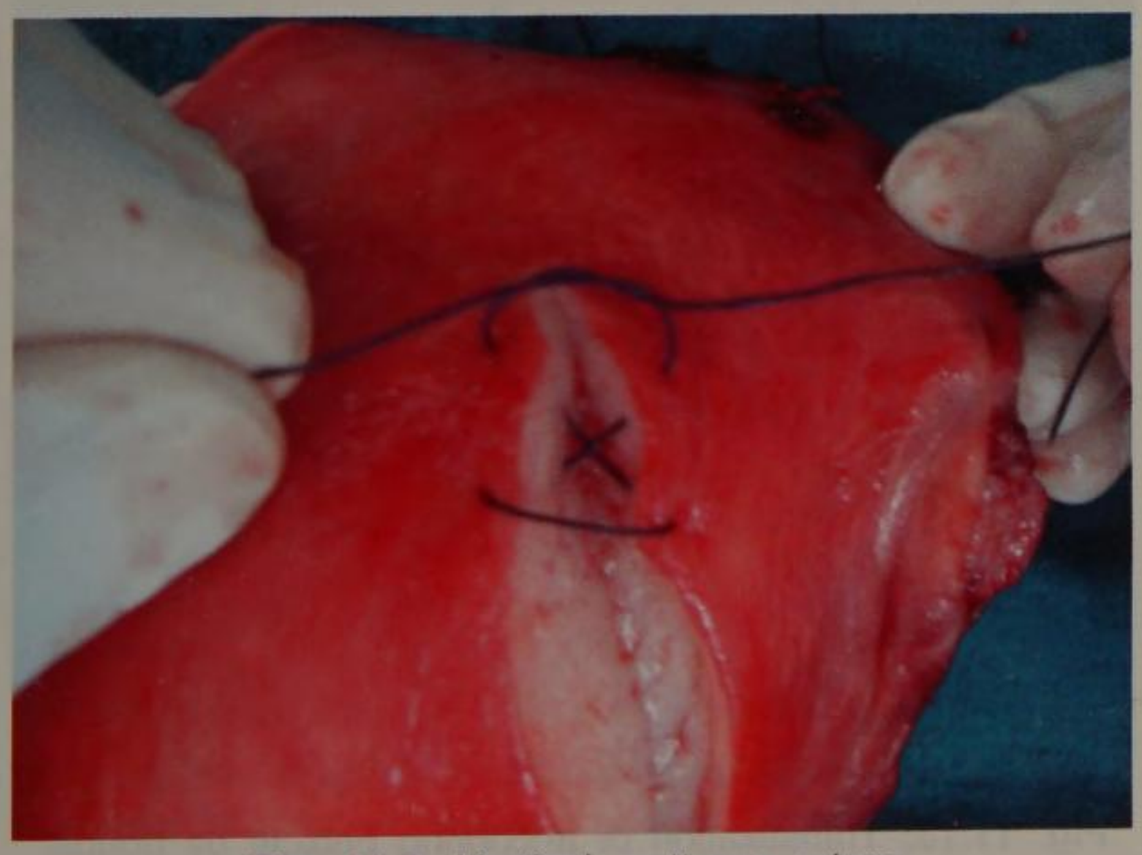

Fig. 11.9: Vertical mattress suture

Advantages

1. Maximizes wound eversion.
2. Reduces dead space.
3. Minimizes wound tension.

Disadvantage

1. Cross-hatching is greater because of 4 entry point of the stitch.

Far-Near Near-Far Modified Vertical Mattress Suture

Technique

The first loop is placed approximately 4-6 mm from the wound edge on the far side and approximately 2 mm from the wound edge on the near side. The suture crosses the line and re-enters the skin on the original side at 2 mm from the wound edge on the near side. The suture exists the skin on the opposite side 4-6 mm away from the wound edge on the far side. This placement creates a pulley effect.

Advantage

1. The pulley suture is useful when expansion is desired.

Horizontal Mattress Sutures

Technique

It is placed by entering the skin 5 mm to 1 cm from the wound edge. The suture is passed deep in the dermis to the opposite side of the suture line and exists the skin equidistant to the wound edge (in effect, a deep simple interrupted stitch). The needle re-enters the skin on the same side of the suture line 5 mm to 1 cm lateral of the exit point. The stitch is passed deep to the opposite side of the wound where it exits the skin and the knot is tied (Fig. 11.10).

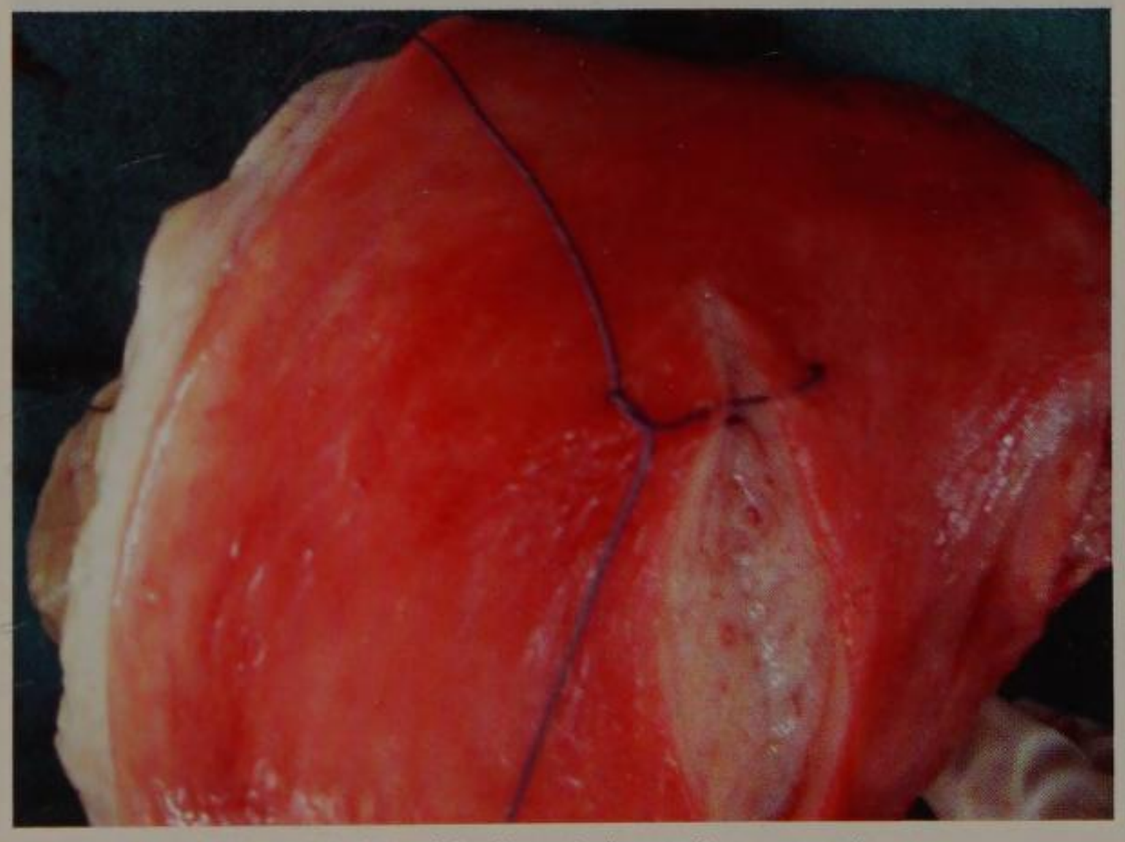

Fig. 11.10: Horizontal mattress suture

Advantage

1. Useful for wounds under high tension. May be used as a stay stitch to temporally approximate wound allowing placement of simple interrupted or subcuticular suture.

Disadvantages

1. Risk of producing scar marks if left in place for longer than 7 days.
2. Risk of tissue strangulation and wound edge necrosis if tied too tightly.

Running Subcuticular Sutures

Technique

The running subcuticular suture is placed by taking horizontal bites through the papillary dermis on alternating sides of the wound. No suture is visible and suture may be left in place for several weeks (Fig. 11.11).

Advantages

1. Good cosmetic result.
2. Eliminates cross hatching.

Disadvantages

1. Does not provide wound strength.
2. Requires precise approximation of wound edges.

They are best preserved for wounds in which tension has been eliminated with deep sutures and wound edges are of approximately equal thickness.

TRANSFIXATION OF VARIOUS PEDICLES[11]

Vascular Pedicles

1. A single free tie is taken around the pedicle and tied.
2. A single needle penetration of the pedicle but base doubly tied (Fig. 11.12).

Anchoring Pedicles

1. After a small loop over the toe of the hemostat has been tied, a second loop goes around the entire pedicle and is tied.
2. Double penetration of the pedicle making interlocking loops which provide additional security (Fig. 11.13).
3. Double penetration of the pedicle that leaves a small portion unligated (Fig. 11.14).

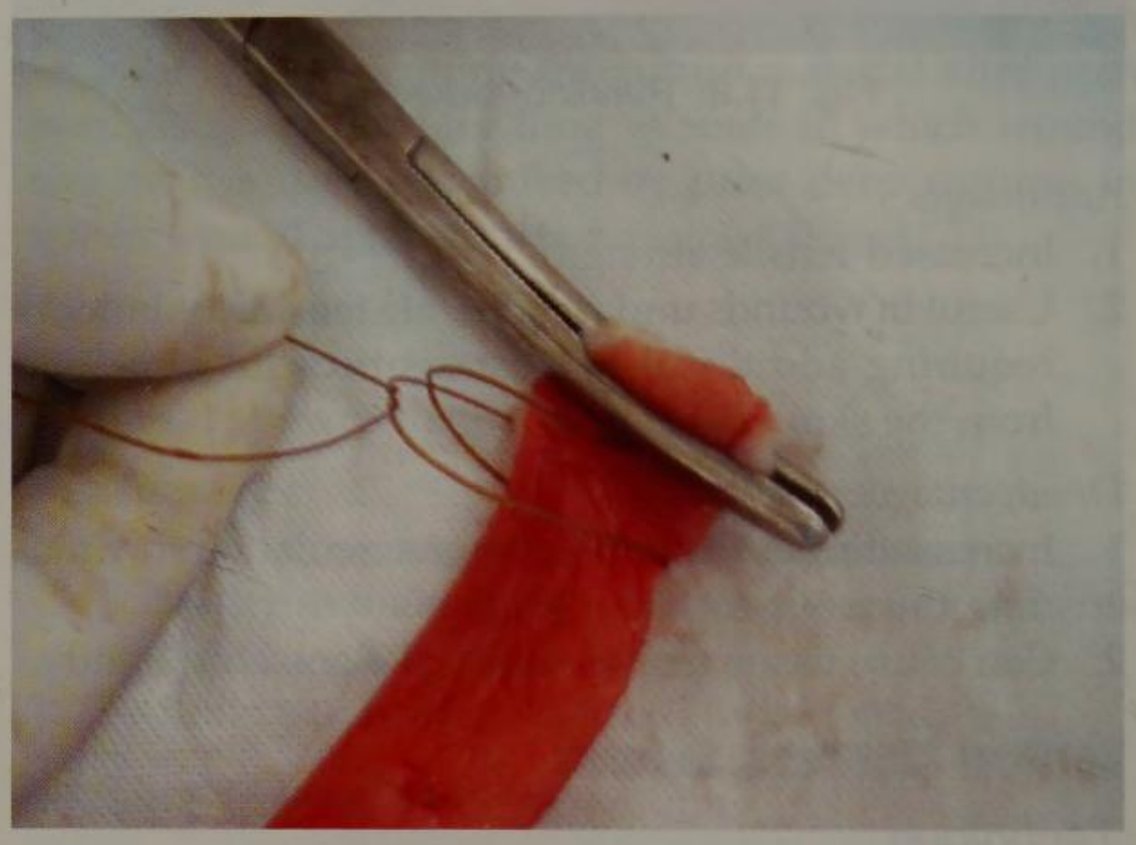

Fig. 11.12: Transfixation of vascular pedicle by single needle penetration but base doubly tied

Fig. 11.11: Running subcuticular suture

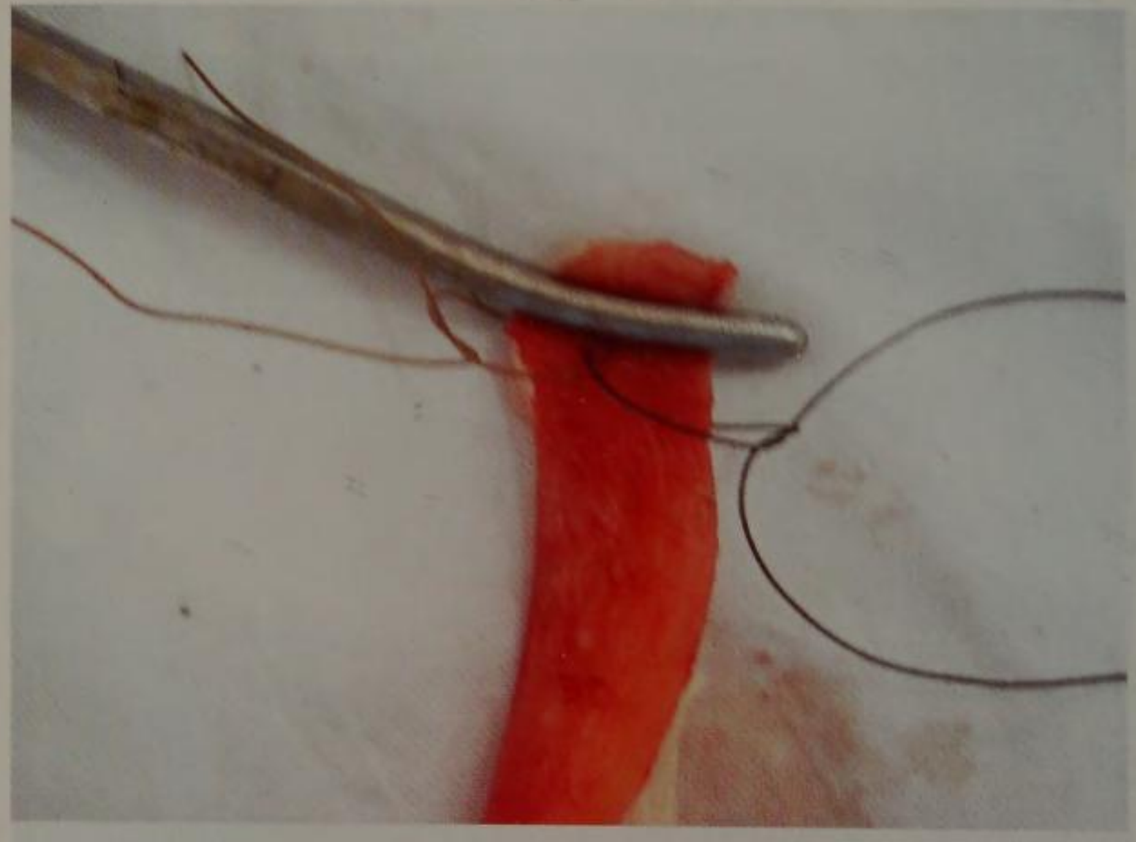

Fig. 11.13: Transfixation of anchoring pedicle by double penetration with interlocking loops

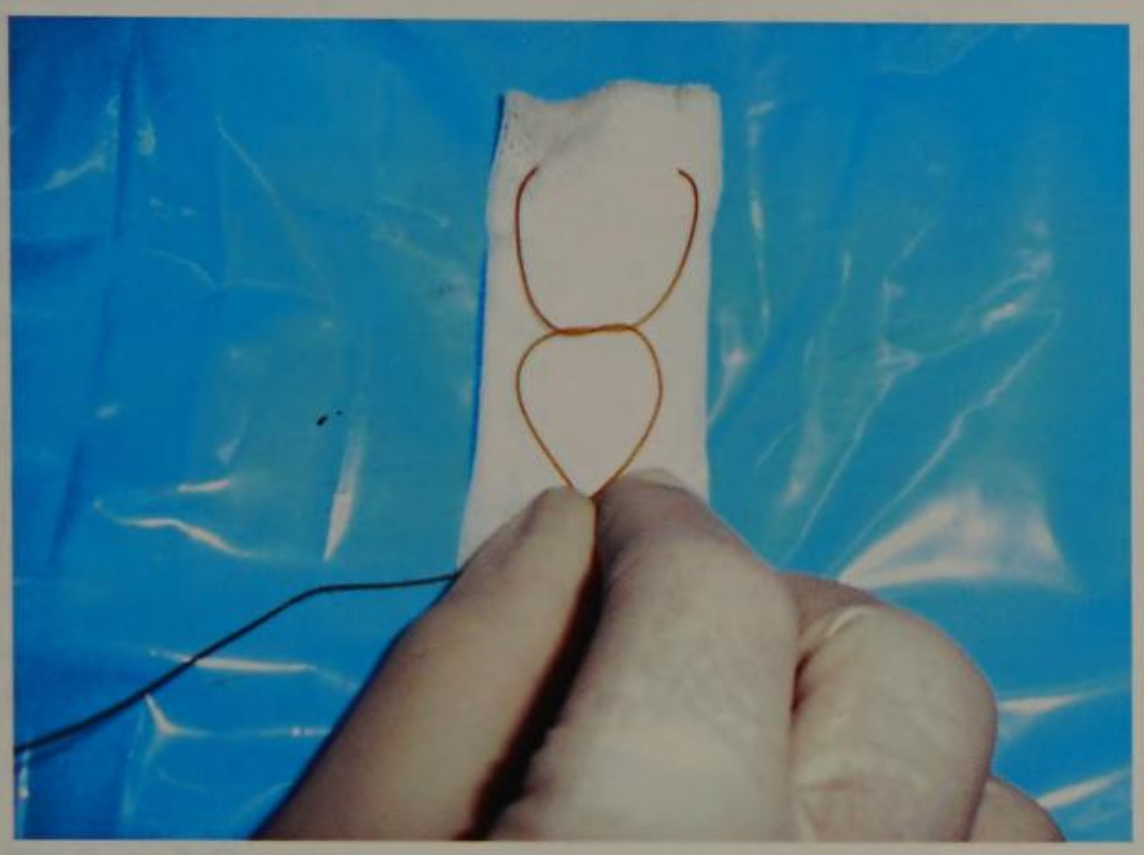

Fig. 11.14: Transfixation of anchoring pedicle by double penetration leaving a small portion unligated

OBLITERATION OF DEAD SPACE

Purse String Suture

Technique

The suture is passed in a circular manner taking the edges of the dead space and tied thereby bringing the edges together (Fig. 11.15).

Advantage

1. Obliteration of dead space.
2. Hemostasis

Fig. 11.15: Purse string suture

Figure of 8 sutures (Fig. 11.16)

Technique

The suture is placed by entering perpendicular to the tissue and exiting on the opposite site. The suture crosses and re-enters on the original site and exits on the opposite site. The knot is tied thereby creating a figure of '8.'

Advantage

1. Hemostasis.
2. Obliteration of dead space.

KNOT TYING TECHNIQUES

All surgical knots can be divided into two basic groups – flat knots (square, surgeon's, and granny) and sliding knots (identical and nonidentical).[1,12]

Flat Knots

Flat knots are formed with half hitches tied with equal tension on the ends of the suture. The flat square knot is the most secure of all the surgical knots.

Surgeon's knots are constructed by an initial double wrap throw by a single throw (Figs 11.17 to 11.19).

Sliding Knots

Sliding knots are two half hitches either non-identical (square knot) (Fig. 11.20) or identical (granny knot) (Fig. 11.21), tied with tension on one segment than the other. The term sliding knot suggests the tendency of

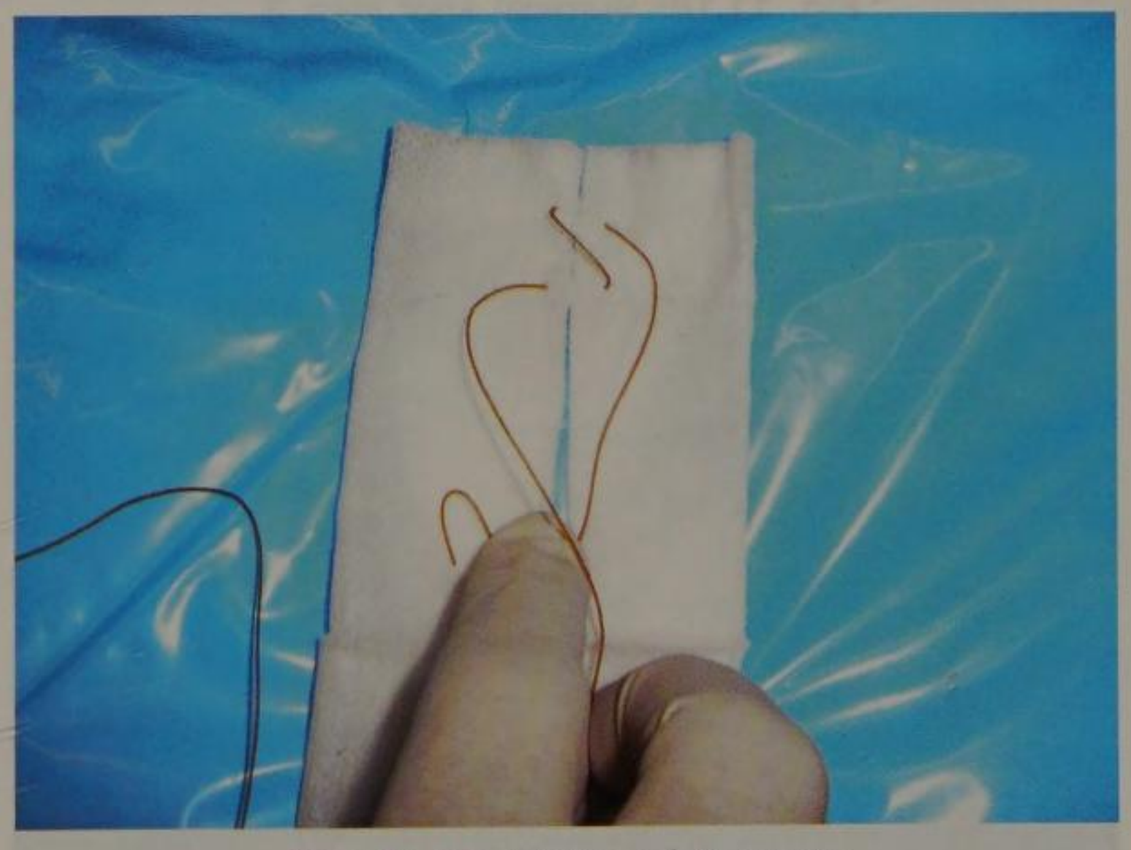

Fig. 11.16: Figure of 8 suture

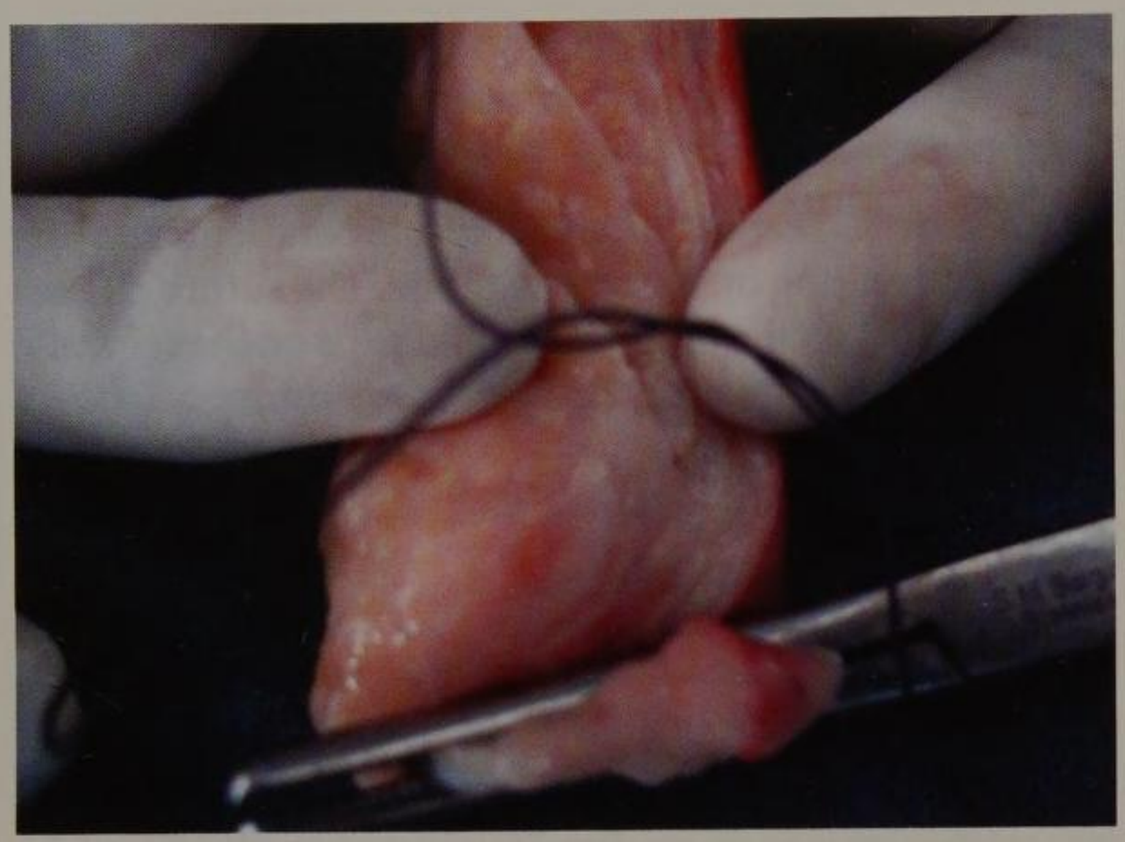

Fig. 11.17: Surgical knot step 1

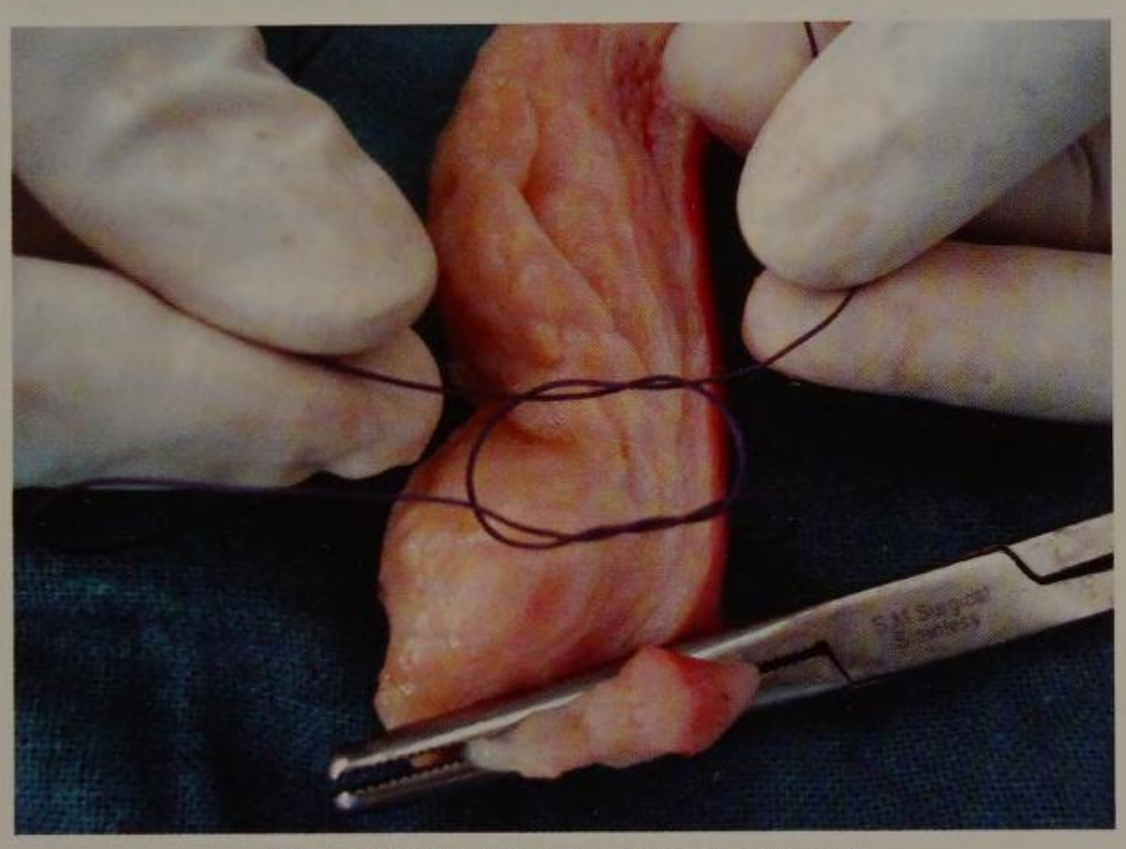

Fig. 11.18: Surgical knot step 2

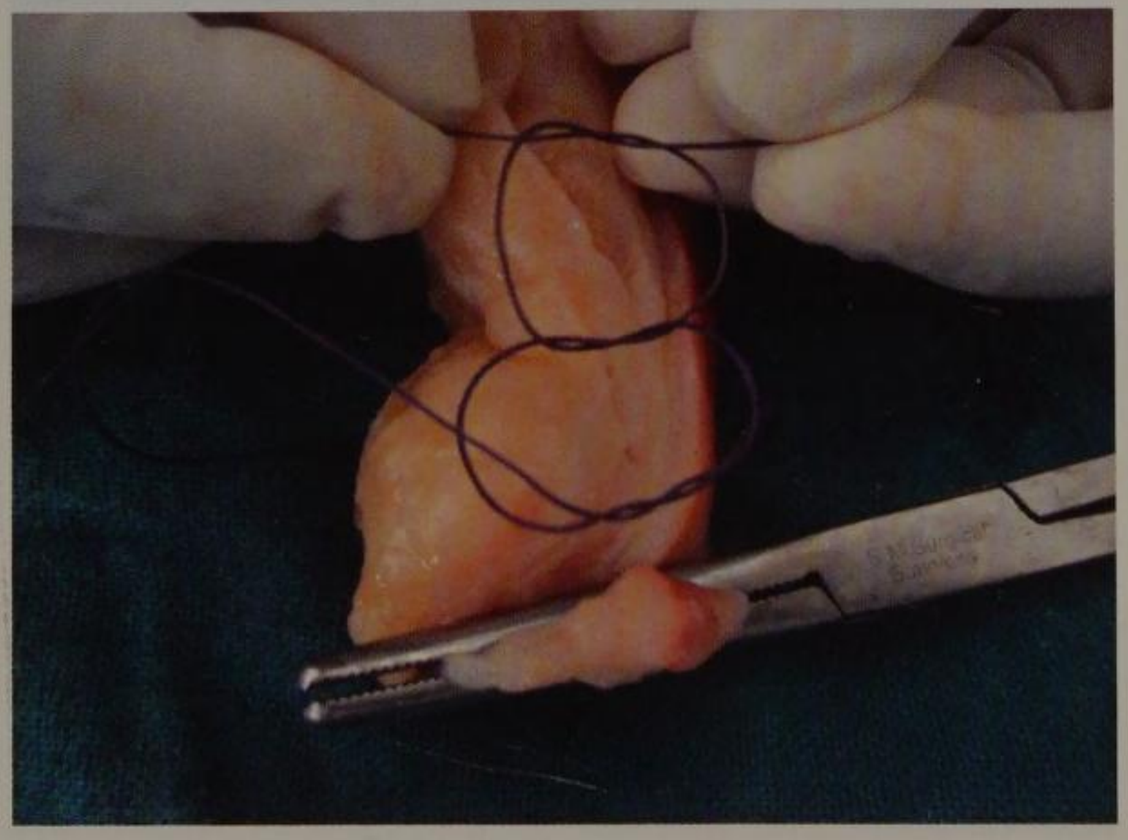

Fig. 11.19: Surgical knot step 3

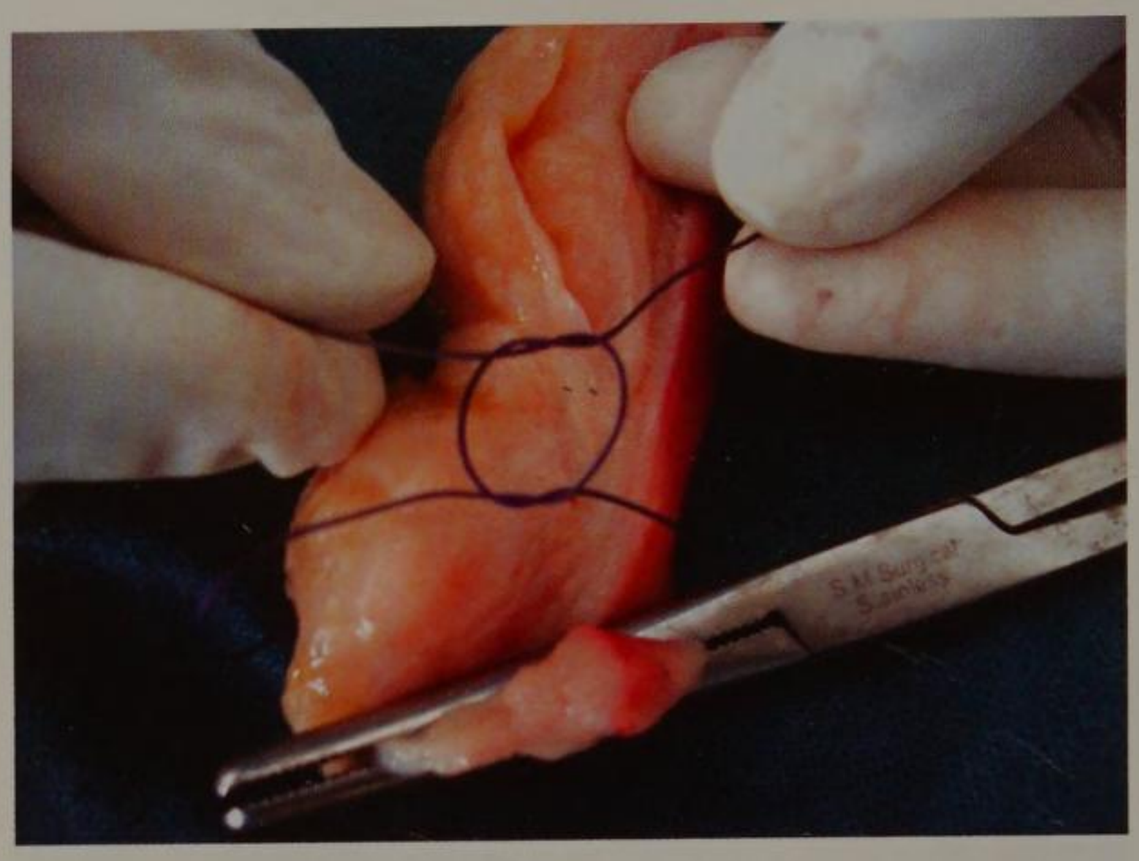

Fig. 11.20: Square knot

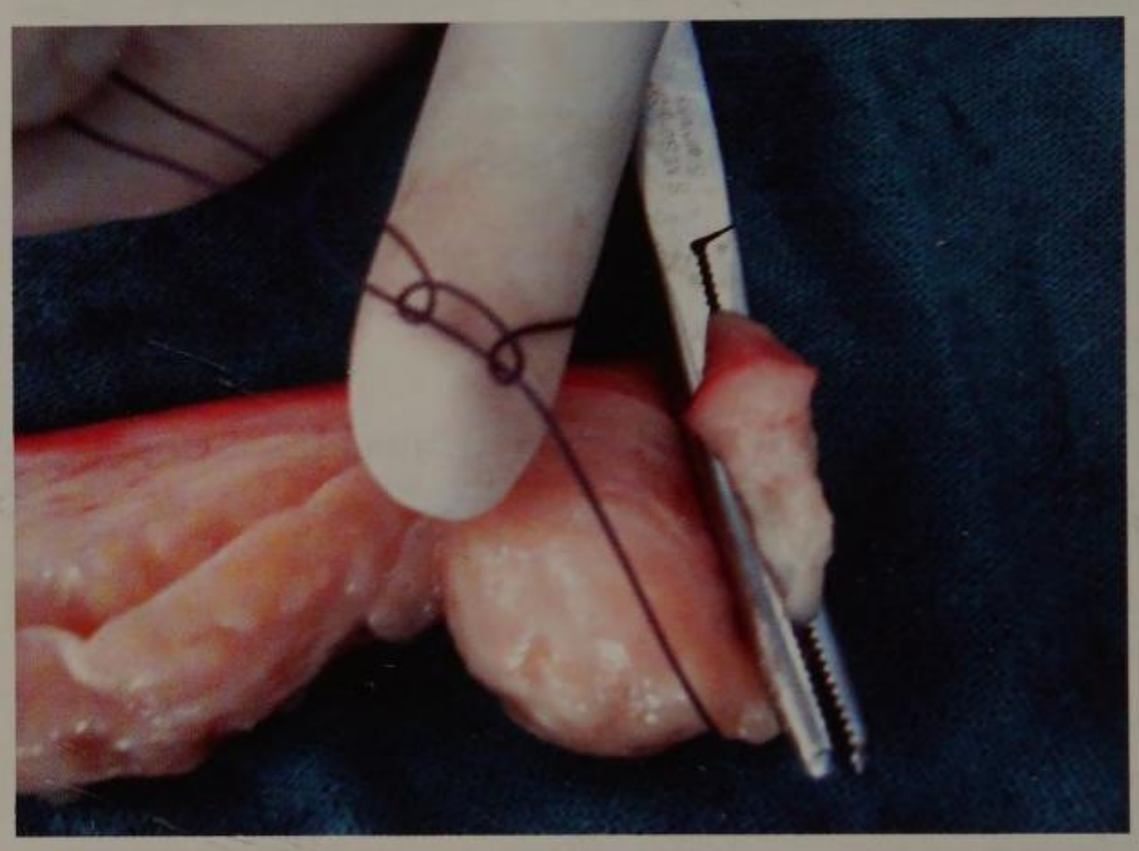

Fig. 11.21: Granny knot

the knot to slip compared to the flat, but this is not completely true. Sliding knots are more commonly used by gynecologists than square knots. The reason being, the crossing of the surgeon's hands needed to tie square knots unavoidably releases tension on the knot, and this can lead to knot slippage. The tying of deep ligatures is most easily performed by keeping constant tension on one suture. Whichever knot is used, the operator should be aware of the knot being used and the number of throws needed to obtain maximum knot-capacity.

ALTERNATIVE METHODS OF WOUND CLOSURE

Steri-Strips

Wound closure tapes, or Steri-Strips, are reinforced microporous surgical adhesive tape. Steri-Strips are used

to provide extra support to a suture line, either when running subcuticular sutures are used or removed. Wound closure tapes may reduce spreading of the scar if they are kept in several seeks after suture removal. Often, they are used with a tissue adhesive. These tapes are then used for primary wound closure.

Staples

Stainless steel staples are frequently used in wounds under high tension, including wounds on trunk. Advantages of staples include quick placement, minimal tissue reaction, low risk of infection and strong wound closure.

Tissue Adhesive

Superglues that contain acrylates may be applied to superficial wounds to block pinpoint skin hemorrhages and to precisely coapt wound edges. The usefulness of rapidly polymerizing plastics is limited because of the difficulty in handling the adhesive and the potential for tissue toxicity and inflammation. The use of tissue adhesives in dermatologic surgery is still evolving. As new and improved products are developed, the use of adhesives for skin closure may increase.[13]

CONCLUSIONS

Sutures are divided into various types according to the absorption rate, tensile strength and type of material they are made of. They are numbered in digits and zeros. With the available knowledge, the surgeon is able to use the right suture for the right tissue and knowledge of suturing technique and knotting, desired tensile strength can be obtained. In vaginal surgeries, non-absorbable sutures are seldom used. The place of Vicryl, Monocryl and chromic catgut has stood the test of time.

KEY POINTS

1. An ideal suture should be sterile, easy to handle, holds securely when knotted, causes minimal injury, should be resistant to infection and have high tensile strength.
2. Absorbable sutures loose their tensile strength within 60 days.
3. Natural sutures are absorbed via inflammatory reaction by tissue enzymes while synthetic sutures are absorbed by hydrolysis.
4. Goals for suturing include closure of dead space, supporting and strengthening wound until healing occurs, approximation of edges and decreased risk of infection and bleeding.
5. The choice of sutures and needles determined by location of lesion and the thickness of tissue in that location.
6. Anchoring pedicles should always be transfixed to ensure security.
7. Flat square knots are the most secured and desirable.

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12 Instruments for Vaginal Surgery

Shalini Rajaram, Harsha Sharma, Nitin Agarwal

INTRODUCTION

Effective and successful surgery is not only dependent on the surgeon's judgement and technical competence, but also on the choice of appropriately designed instruments. No set of instruments will consistently be associated with a satisfactory surgical result without the skill of the surgeon. The carpenter is more important than his or her tools, but fine tools may help improve the carpenter's work. There are significant choices available in the surgeon's armamentarium, and the right choices will enable the operator to accomplish with greater ease and efficiency any surgical technique. This chapter is an effort to familiarize the reader with basic vaginal surgery instrumentation and advantages of individual instruments.

Lighting

There should be adequate lighting. When this is directed over the right-handed surgeon's left shoulder, illumination should be shadow free. Most operating room lighting has been designed to illuminate the operative field during a laparotomy and is often not adaptable and will not provide adequate illumination into the horizontal axis of a relatively deep pelvic cavity, such as the vagina. When adequate overhead lighting adaptable for vaginal surgery is not available, movable spotlights are necessary, but these often have an inherent and annoying tendency to move or slide out of focus as a result of the movements of operating room personnel. A surgeon may find it useful to wear a fiberoptic or tungsten headlight, which will provide a shadowless spot from 2 to 4 inches of very bright light in the centre of the operative field (Figs 12.1 and 12.2). Because the wearer

Fig. 12.1: Spotlight

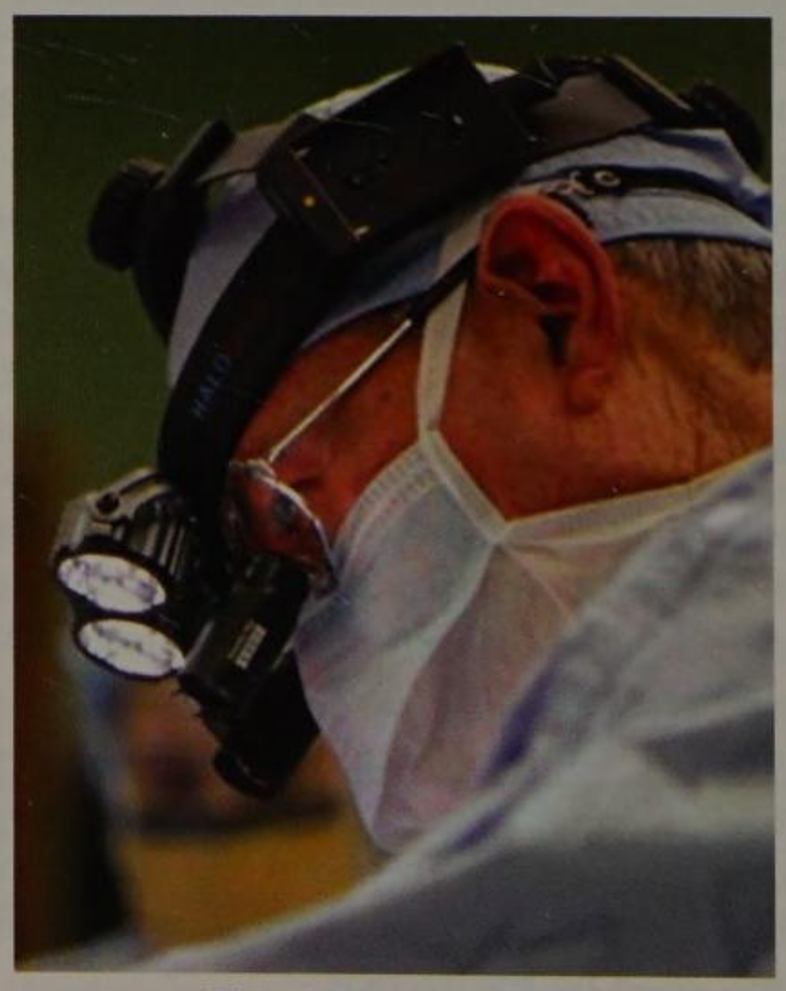


Fig. 12.2: Headlight

is in control of the position of the light from the headlight at all times, it can be quite helpful (see chapter 9 for details on OT lighting).[1, 2]

Operating Table

The operating table to be used for vaginal surgery should be equipped with adjustable stirrups that can be extended at least a foot or more according to the length of the patient's legs. These should be placed in such a fashion that when the patient's ankles are suspended from the stirrups, acute angulation of the leg will be avoided to ensure unobstructed venous return. Excess external rotation of the hip should be carefully avoided to lessen the chances of pathologically stretching the sciatic, peroneal, or femoral nerves.

The patient should be so positioned on the operating table that an imaginary line drawn between the two stirrups will intersect each acetabulum or hip socket. The operating table should also be equipped to ensure rapid adjustment into varying degrees of Trendelenburg and reverse Trendelenburg positions, as occasionally emergency circumstances may require. The table height should be sufficiently adjustable to permit the operator either to stand during the operative procedure or to be seated if that is his or her preference.

If a lithotomy sheet is used, it should have ample casings for the feet, so that it can be placed in position readily even though the patient's legs are placed somewhat vertically in the extended leg holders or stirrups.

Elastic stockings for the patient are advisable and should be in place before the start of anesthesia. Whether their use will significantly reduce postoperative pulmonary embolism may be debatable, but they do provide venous compression. When the patient's legs are taken out of the stirrups and are lowered into the horizontal recumbent position at the conclusion of the operative procedure, the resultant rapid pooling of blood into the large venous beds of the legs is reduced. Lowering the legs without compression as they come down out of the stirrups may result in a precipitous and significant drop in blood pressure as a result of what, in effect, has been a sudden increase in the size of the venous pool into which a fixed volume of blood is circulating. Intermittent compression boots are recommended for the patient with a history of previous phlebitis of the lower extremity or pelvis.[2]

Retractors

Appropriate retractors are the key to success in vaginal surgery. One must use retractors designed to retract the tissue at the right level without deepening the working area and providing adequate exposure of the surgical field. Various retractors used in vaginal surgery are (Figs 12.3 to 12.8):[1-3]

1. Deaver retractor
2. Heaney retractor
3. Breisky-Navratil retractor

Fig. 12.3: Deaver retractors of various lengths

Fig. 12.4: Heaney right angle retractor

Fig. 12.5: Breisky-Navratil vaginal retractor

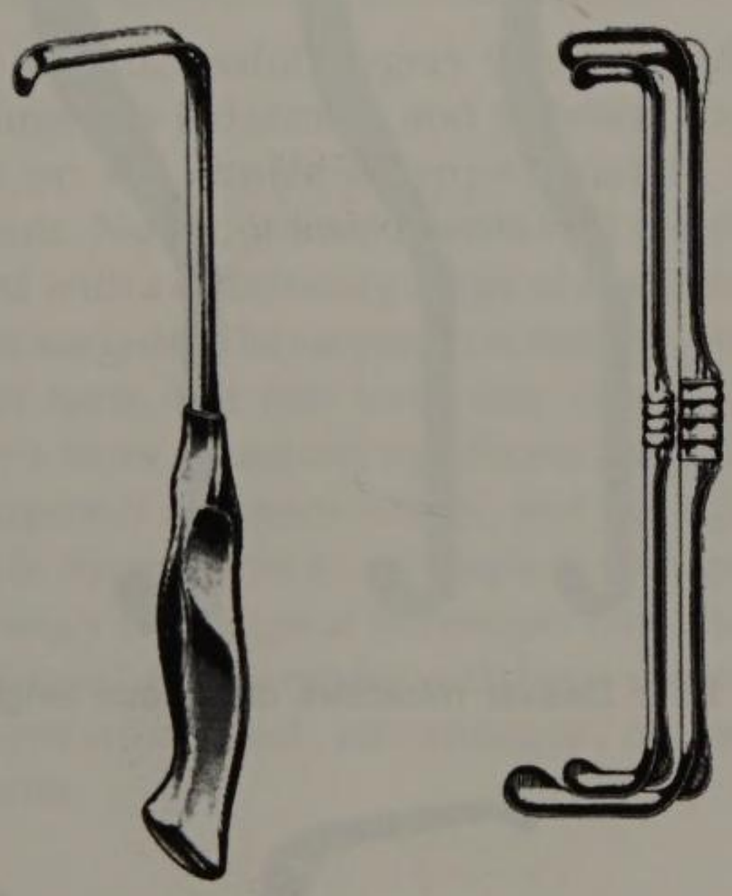


Fig. 12.6: Richardson retractor and its Eastman modification

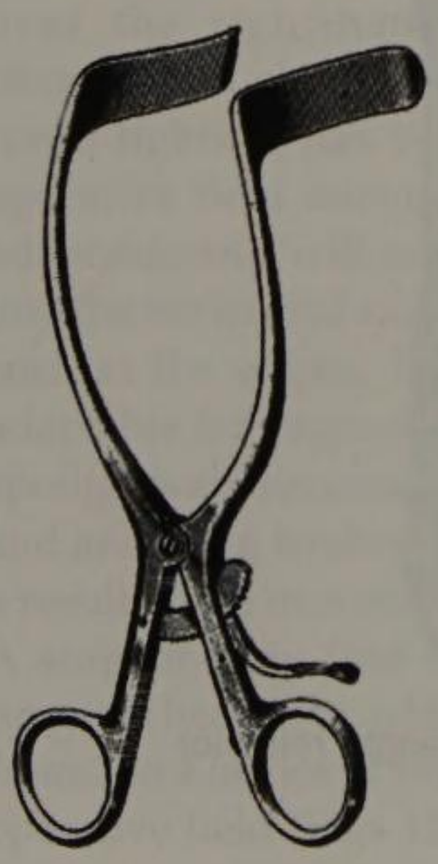


Fig. 12.7: Rigby self-retaining vaginal retractor

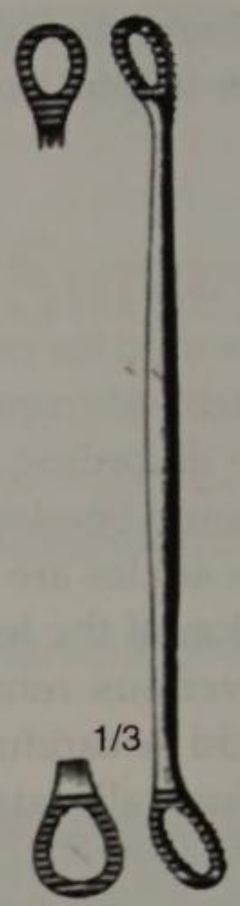


Fig. 12.8: Sim's anterior vaginal wall retractor

4. Richardson retractor
5. Self-retaining retractor
6. Sims' anterior vaginal wall retractor.

Deaver Retractor

The design of the Deaver retractor has also been modified in varying lengths and widths to make it useful in both vaginal and abdominal surgeries. If the Deaver retractor is placed too deeply, the assistant's hand and the bulge of the retractor's curve may limit the operator's vision. It is not unusual to use several different handled retractors during the course of an operation. The surgeon should direct the positioning of the retractors by the assistants and choose the most appropriate retractor for the particular surgical step. The advantage of the Deaver's retractor is its thin blade which occupies little space and is an ideal instrument for retraction while operating in depth.

Heaney Retractor

The Heaney retractor is a right-angled vaginal retractor that is found on almost every vaginal surgery set. This retractor will easily extend to the depth of the cervix in most patients and can be useful for exposure of the cervix, vaginal fornices, and the vaginal exposure to the peritoneal cavity. The long blade on the large Heaney retractor has the disadvantage of sometimes pushing the operative site away from the surgeon, particularly when the vaginal mucosa is intact. A smaller version of the

Heaney retractor has been manufactured for circumstances in which a shorter blade is more desirable. The abrupt bend of the retractor can occasionally interfere with visualization at the introitus; other retractors with a rounded curvature are more appropriate when this happens.

Breisky-Navratil Retractor

The Breisky-Navratil retractors are widely used for vaginal exposure among European gynaecologic surgeons but are less popular in the United States. These retractors have the advantage of a curve that will allow a lateral, superior, or inferior tow on the vaginal tissue without the assistant's hand drifting into the operator's field of view. These retractors come in a variety of lengths and widths that expand the usefulness of the basic design. This retractor is especially useful for deep exposure as in sacrospinalis fixation of the vaginal vault. Its shape allows for medial retraction of the rectum without interfering with application of the supporting sutures in the sacrospinous ligament.

Richardson Retractor

The Richardson retractor and the Eastman modification are favourites of gynaecologic surgeons. These designs are useful in both abdominal and vaginal operations. They are beneficial in opening and closing incisions when it is desirable to directly visualize the fascial surface. They can also be useful for lifting the abdominal wall or enhancing exposure in the pelvis. The curved tip of the blade favours the traction on tissue but is capable of damage by digging into tissue if too much force is applied.

Self-retaining Retractor

This retractor is self-retaining and thus the need for an assistant is obviated. However, it has certain disadvantageous. It causes prolonged compression of the retracted tissues so that their vitality is reduced. Also the retraction obtained is fixed.

Sims' Anterior Vaginal Wall Retractor

This instrument is a long instrument with spoon-shaped ends which have transverse serrations on either surface. The loops make an angle of 150° with shaft and are angled in opposite directions. The transverse serrations on its looped ends provide friction against rugous vaginal mucosa and aid efficient retraction.

Speculums

The various kinds of speculums used in vaginal surgeries are (Figs 12.9 to 12.11):[1-3]

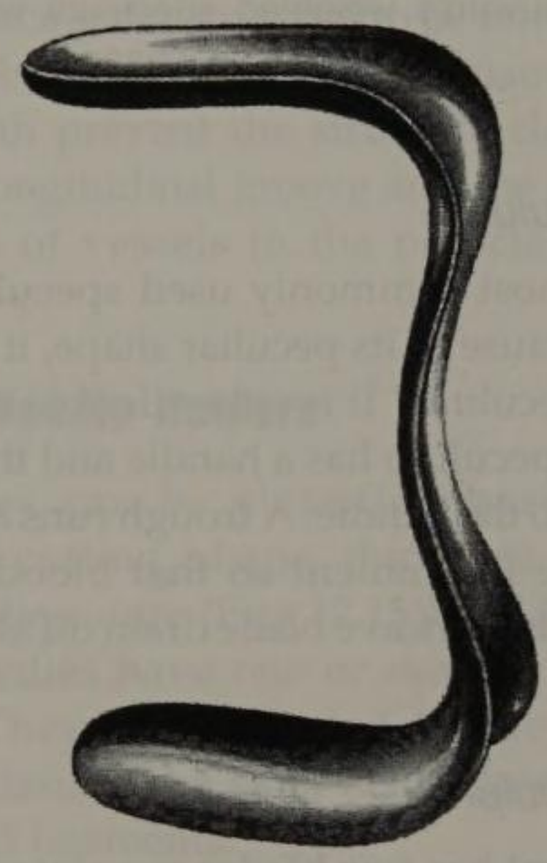
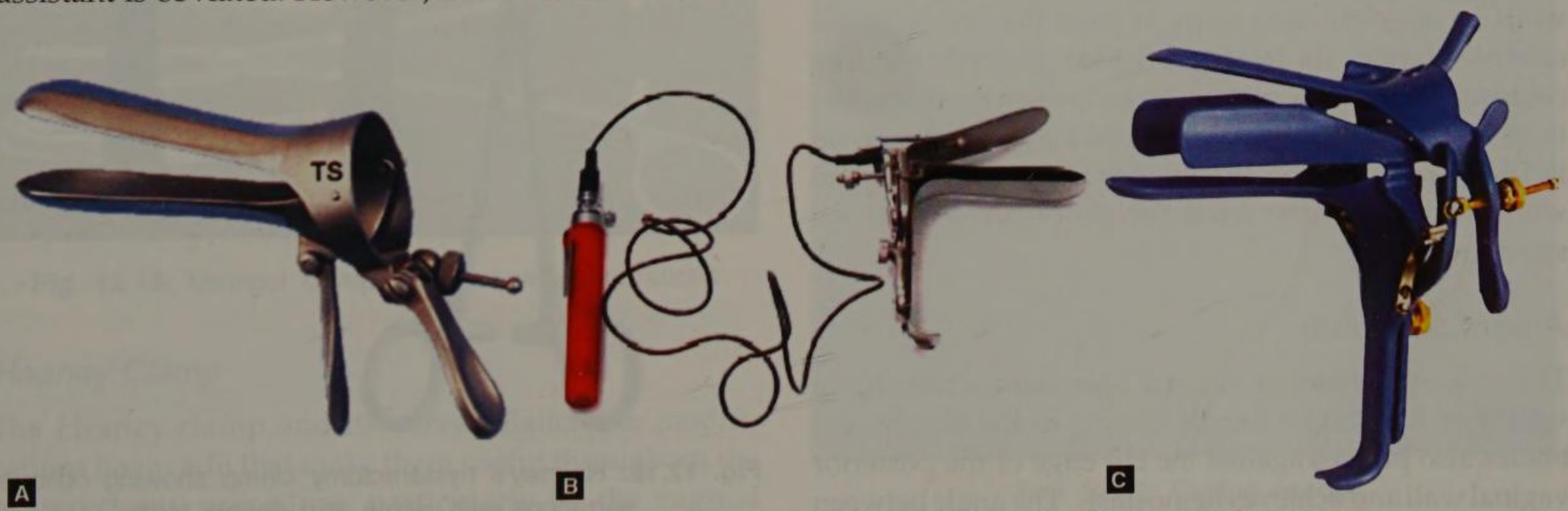


Fig. 12.9: Sim's speculum



Figs 12.10A to C: (A) Cusco's speculum, (B) Lighted Cusco's, (C) Plastic Cusco's

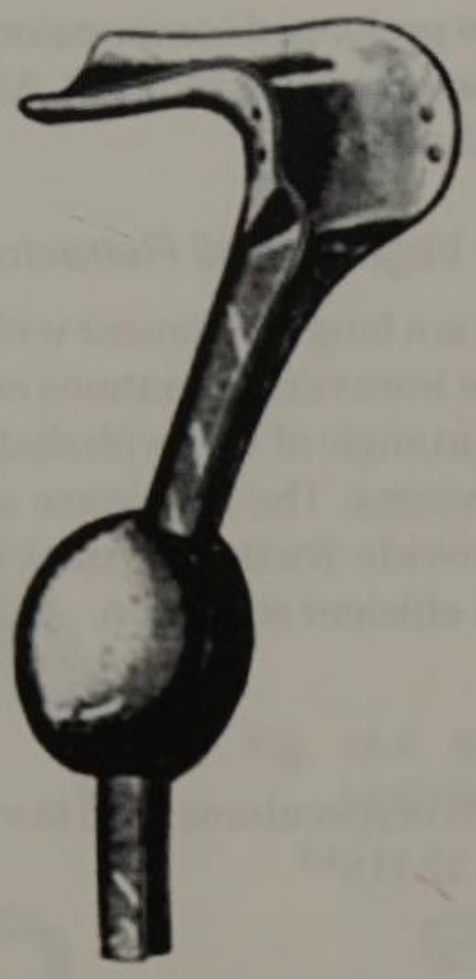


Fig. 12.11: Auvard's weighted speculum with a 45° angle and a suction channel

Sims' Speculum

This is the most commonly used speculum in vaginal surgeries because of its peculiar shape, it is also called a 'duck-bill speculum.' It is either double ended or single ended. The speculum has a handle and the blades are at right angles to the handle. A trough runs along the entire length of the instrument so that blood or secretions collecting in the concave blade drain off along the trough in the handle.

Cusco Speculum

The instrument has two blades connected by a hinge so that they can open and close around a transverse axis. Because it stretches the anterior and the posterior vaginal walls in opposite directions, it fixes the cervix in the centre. Hence, its best use is for procedures like colposcopy and colpomicroscopy, in which the cervix has to be fixed so that the objective lens may be focussed on it. The speculum covers the anterior and posterior vaginal walls and cannot be used for procedures on these structures.

Auvard Speculum

This is a self-retaining vaginal speculum which has a weight of lead on its handle, owing to the weight, the blades also presses against the cut edge of the posterior vaginal wall and achieves hemostasis. The angle between the blade and handle is somewhat less than 90° so that there is a component of the downward force of gravity in the direction towards vagina and this prevents the speculum from slipping out.

Hysterectomy Clamps

The premier operation of the gynaecologic surgeon is the hysterectomy. Whether this operation is performed through the abdominal or vaginal route, it is necessary to effectively control the rich vascular supply until the very last pedicle is ligated. A variety of specialised clamps have been designed to accomplish this purpose.

The ideal hysterectomy clamp should maintain a secure grasp on tissue without an excessive crushing force. A hysterectomy, no matter how carefully performed, is a traumatic procedure. The vascular supply is extensive and well collateralised, and in the paracolpos and parametria, the vessels are surrounded by dense supporting structures. The hysterectomy clamp must be able to firmly grasp and hold these structures until the pedicles are severed and secured by sutures. The relative safety of this operation is largely based on the design and efficiency of use of the hysterectomy clamp. Hysterectomy clamps are designed with a total length of 8 to 9 inches, and may have either a curved or straight tip. The grasping surface can have either oblique, longitudinal or horizontal serrations. The curve of the hysterectomy clamp should be gentle enough to avoid forcing the bite of tissue laterally (Figs 12.12 to 12.14).[4,5]

Fig. 12.12: Heaney's hysterectomy clamp showing oblique serrations with single and double tooth

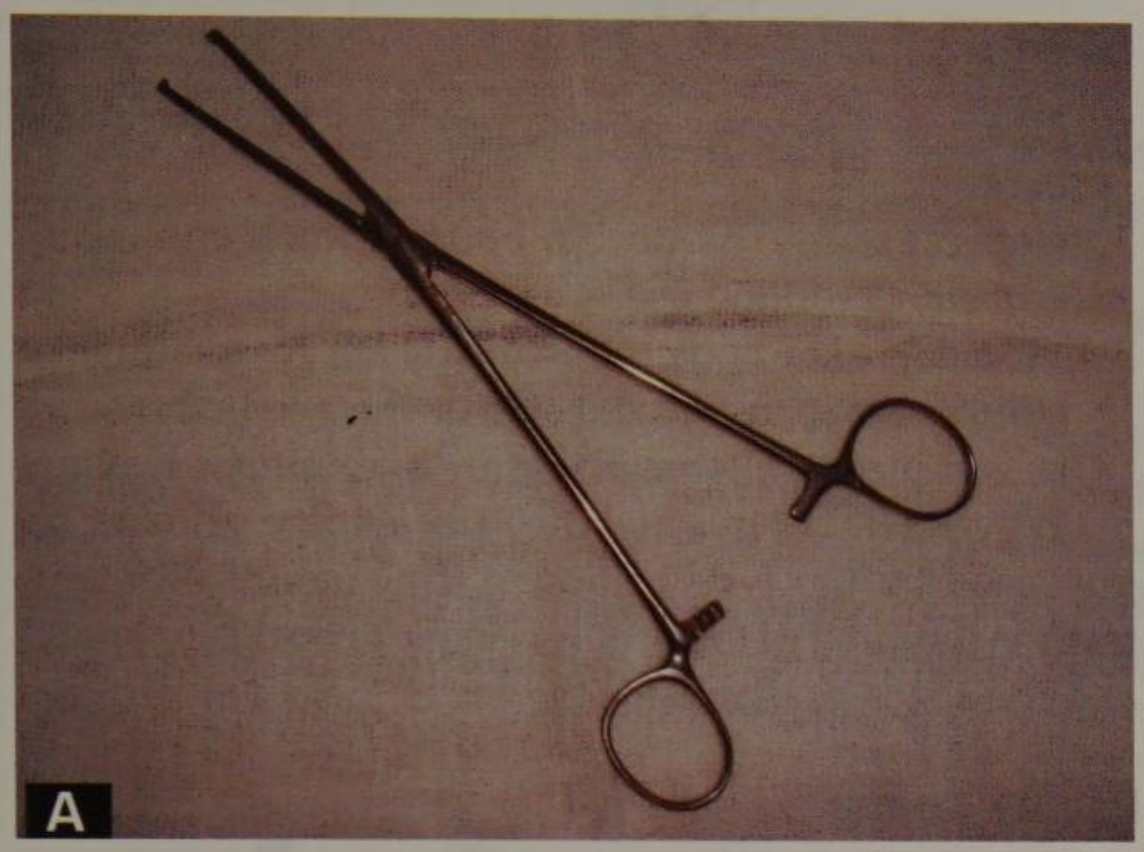


Fig. 12.13A and B: Kocher clamp with transverse serrations

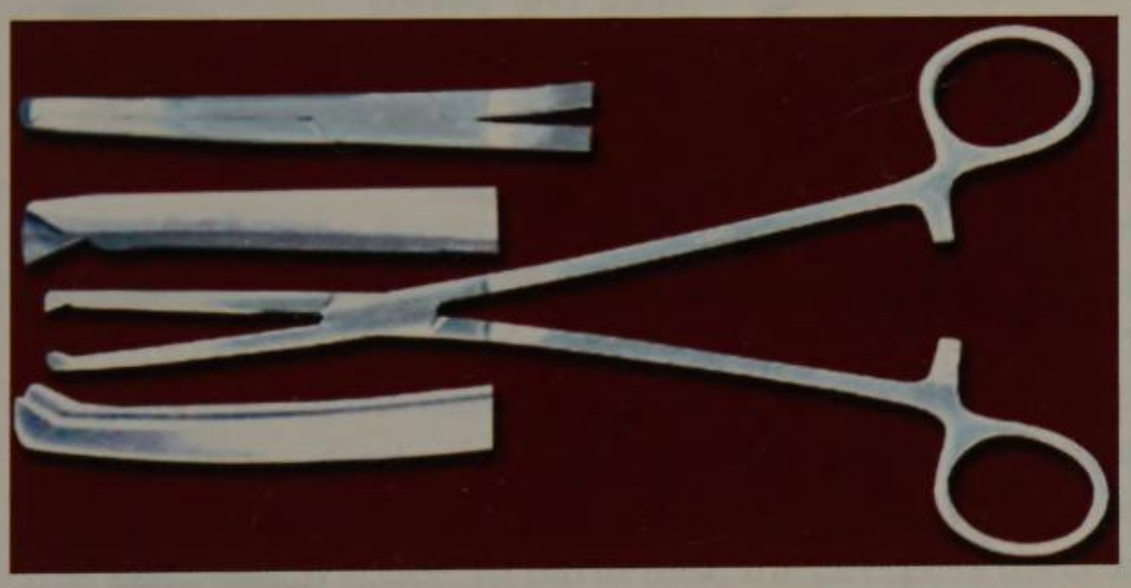


Fig. 12.14: Maingot clamp with transverse serrations

Heaney Clamp

The Heaney clamp and its curved Ballentine modifications have radii that make them useful throughout the hysterectomy procedure, particularly by the vaginal route. The serrations on the Heaney clamp are oblique, and may have either single or double tooth. The coarseness of the serration pattern on the Heaney clamp can also be varied to increase the strength of the tissue grip. The Heaney-Ballentine or curved Ballentine has longitudinal serrations that may be preferable because this design will minimize the risk of lateral slippage of tissue from the clamp.

Kocher Clamp

It has transverse serrations on its blades and is toothed which prevents slippage of the tissue from the clamp.

Maingot Clamp

This instrument has blades with longitudinal ridge which fits in a longitudinal groove on the other blade. The tips of the blades have one on two teeth. The clamp is applied with its curve facing the structure to be removed so that a ligature can be passed around the clamped pedicle easily. The teeth prevent the structure clamped from slipping. The longitudinal groove and the ridge ensure that occlusion of vessels in the pedicle clamped is complete.

Needles and Needle Holders

Suture needles can be classified based on their mechanism of cutting, shape, thickness and type of attachment to the suture (Figs 12.15 and 12.16):

1. Cutting needles have one or more honed cutting surfaces. They are indicated for dense, strong, organized tissues like skin, heavy fascia, cartilage, tendons and ligaments.

Fig. 12.15: Cutting needle

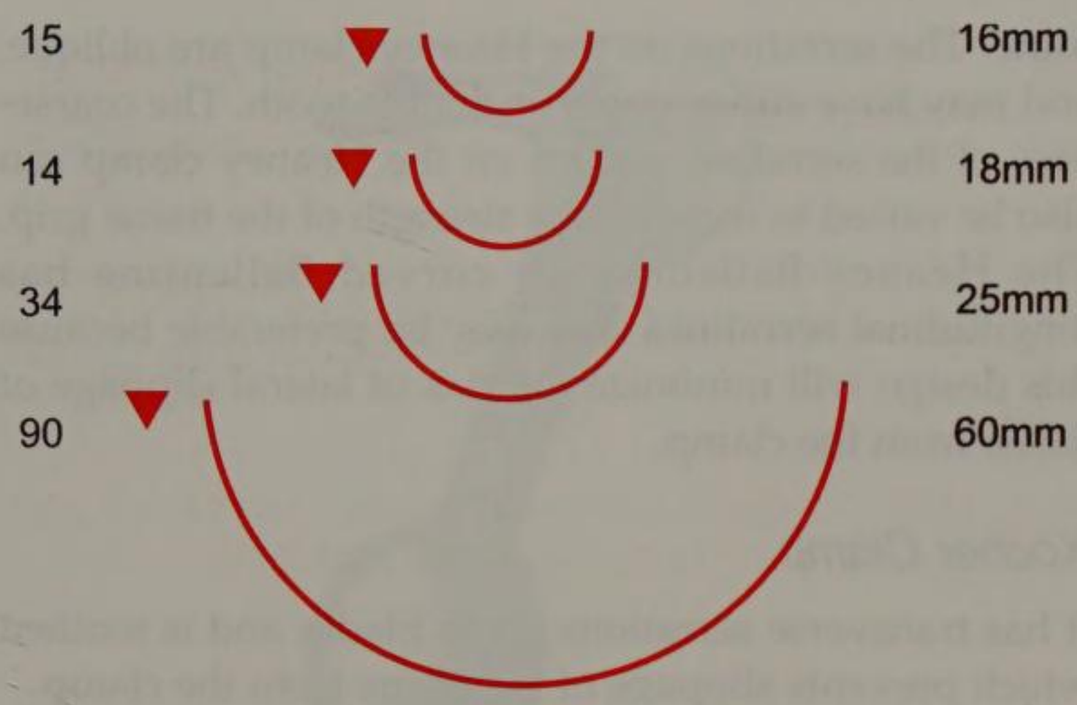


Fig. 12.16: Reverse cutting needle

- Conventional Cutting–The cutting edge is inside the needle curve, toward the surgical wound.
- Reverse Cutting–The cutting edge is outside the needle curve, away from the surgical wound.

2. Taper needles taper to a point. Taper needles are used for less dense tissues - nearly all tissues not listed under indications for cutting needles above - and for tissues which might leak after piercing such as blood vessels.
3. Taper-cut —The needle tapers to a point, but the point is honed to create at least 2 cutting surfaces.
4. Blunt—The needle tapers to a narrower, but blunt point.

Shape

1. Straight—The needle is straight and usually has a cutting surface.
2. Half-curve or Ski—the needle is straight and curves near the point.
3. Curved—The needle is formed in an arc of 1/4, 3/8, 1/2, or 5/8 of a circle.

Attachment to the Suture

1. Eyed Needles—A suture is threaded on the needle by a surgical team member.
   - Standard Eye—The suture must pass through the eye.
   - Spring Eye—The eye is split which permits the eye to be forced over the suture
2. Swaged Needle—The needle is drilled and the suture is inserted into the base of the needle.
3. Controlled Release—A swaged needle which permits the suture to be dislodged from the needle with a purposeful tug for the purpose of performing a hand tie.

Size

1. Heavy—The body of the needle is thick to resist bending.
2. General use—The needle body is thick enough to withstand routine use.
3. Vascular—The body is thin nearly approximating the suture size to assure the size of the needle hole can be completely filled with suture to minimize leaking.

When selecting a needle, the choice should be governed by the type of tissue, the amount of lateral traction required (if the needle is liable to buckle or break) and the space available for the arc of the needle drive.

Needle Holder

The needle holder (Fig. 12.17) must be a strong instrument, whose jaws are properly aligned to hold the needle securely. The force needed to pass the needle through the tissue is a sum total of factors such as tissue resistance, needle suture used and proper application of the driver. Normally, the needle is held perpendicular to the driver; any other angle would necessitate a wider arc of travel.

For vaginal surgeries, most needles should be mounted at 45° and close to the tip of the needle holder. Some, such as Bozeman have curved shanks to enhance visibility of the tip and to facilitate driving the needle in a tight curve. The Turner-Warwick needler holder has been designed to facilitate needle placement in relatively

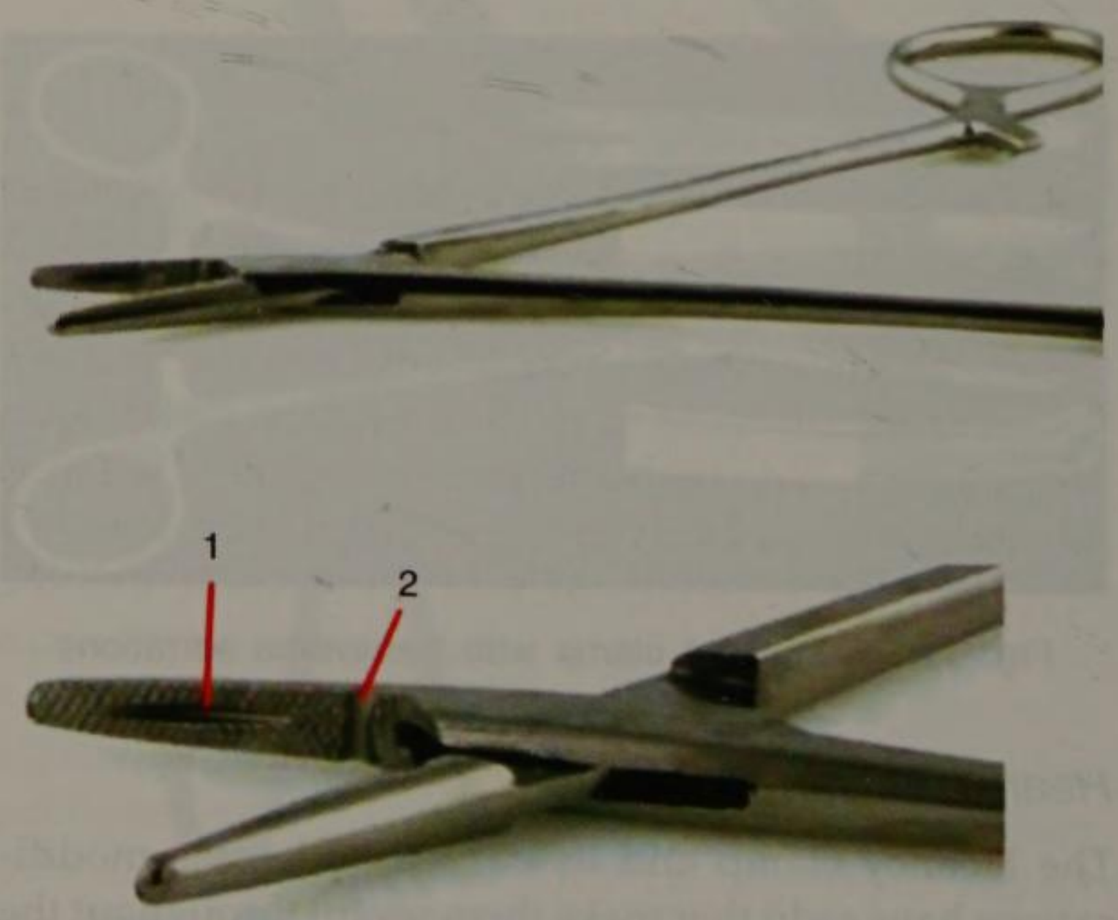


Fig. 12.17: Needle holder

inaccessible position and the Miya's hook for suture insertion in sacrospinous fixation.

For deep pelvic suture ligation, when there is little room to maneuver, placing the needle in the jaws of the holder with the curve parallel to the handles is helpful. The thenar grip is most commonly employed white a palmar grip is used for maximal force.

The Heaney needle holder (Fig. 12.18) is particularly valuable because it provides for a considerable range of angles at which the needle can be grasped. This variability facilitates placement of curved needles and sutures at almost any conceivable angle with relative ease when placing sutures deep within the pelvis.

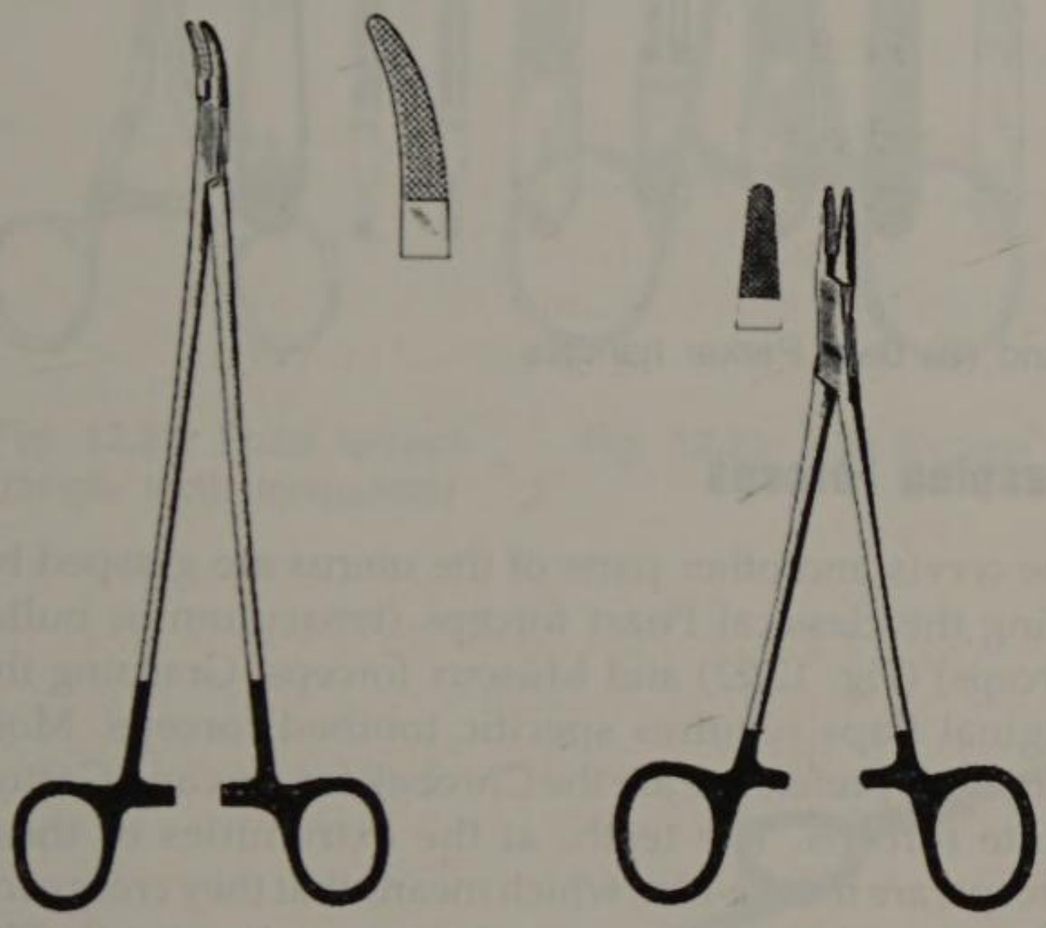


Fig. 12.18: Heaney's needle holder with curved and straight tip

Two historical needles complete vaginal surgery set (Fig. 12.19): the vaginal Deschamps needle and the Emmet needle. The vaginal Deschamps needle is a ligature carrier whose dissecting-penetrating part is in the extension of the handle. The tip of the needle is sharp enough to penetrate the paraisthmic window but blunt enough to avoid injury to the vessel running alongside this anatomical space. In particular, the needle is used to place the lateral ligatures during vaginal hysterectomy. The Emmet needle is a very ancient instrument that was designed to repair obstetric perineal lacerations. It remains the best instrument for the so-called dorsal levator plasty, because it allows one to take an adequate piece of the levator muscles and the perineal body during

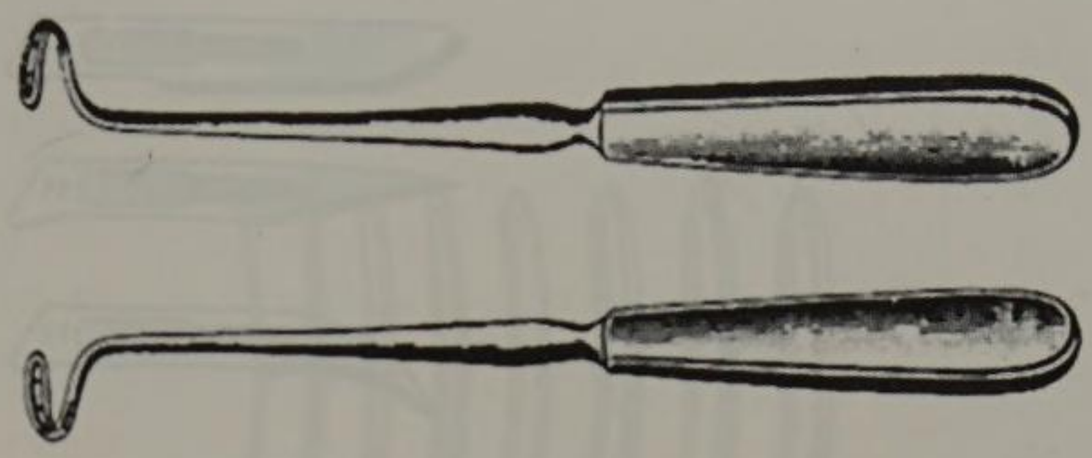


Fig. 12.19: Vaginal Deschamps needle used as a ligature carrier during vaginal hysterectomy

colpoperineorrhaphy, and furthermore, it is one of the best tools for positioning (tension-free) mesh percutaneously; the new prolapse and incontinence surgery.[1,6]

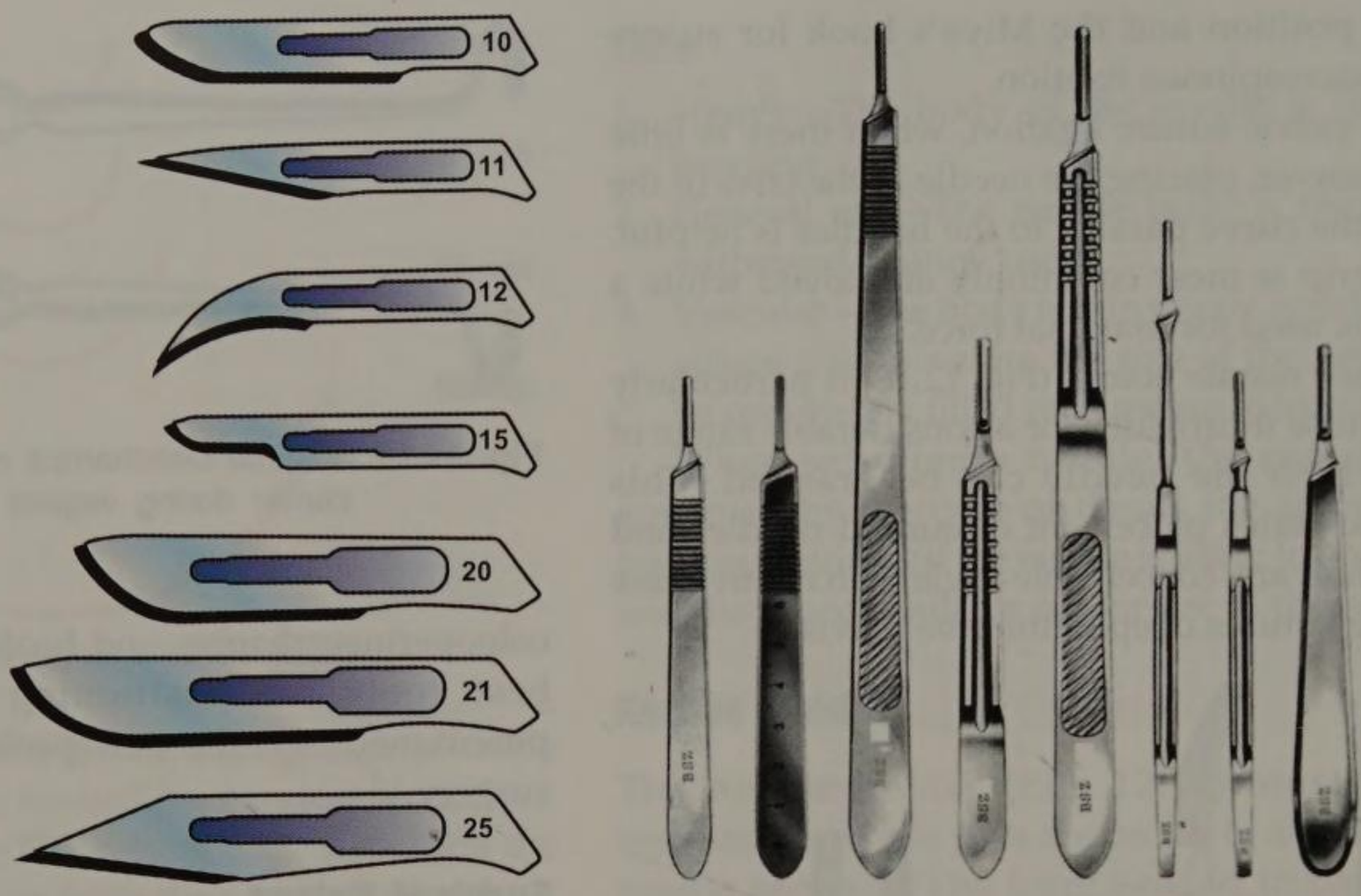
Surgical Knives

The exposure and conduct of a surgical procedure depends on the use of sharp cutting instruments that are properly chosen to accomplish a special task. The traditional surgical scalpel, available in a variety of sizes and shapes, is adequate for most gynecologic procedures. The Bard-Parker handle has a general utility and all blades that are commonly used in gynaecologic surgeries will fit this handle (Figs 12.20A and B).[1]

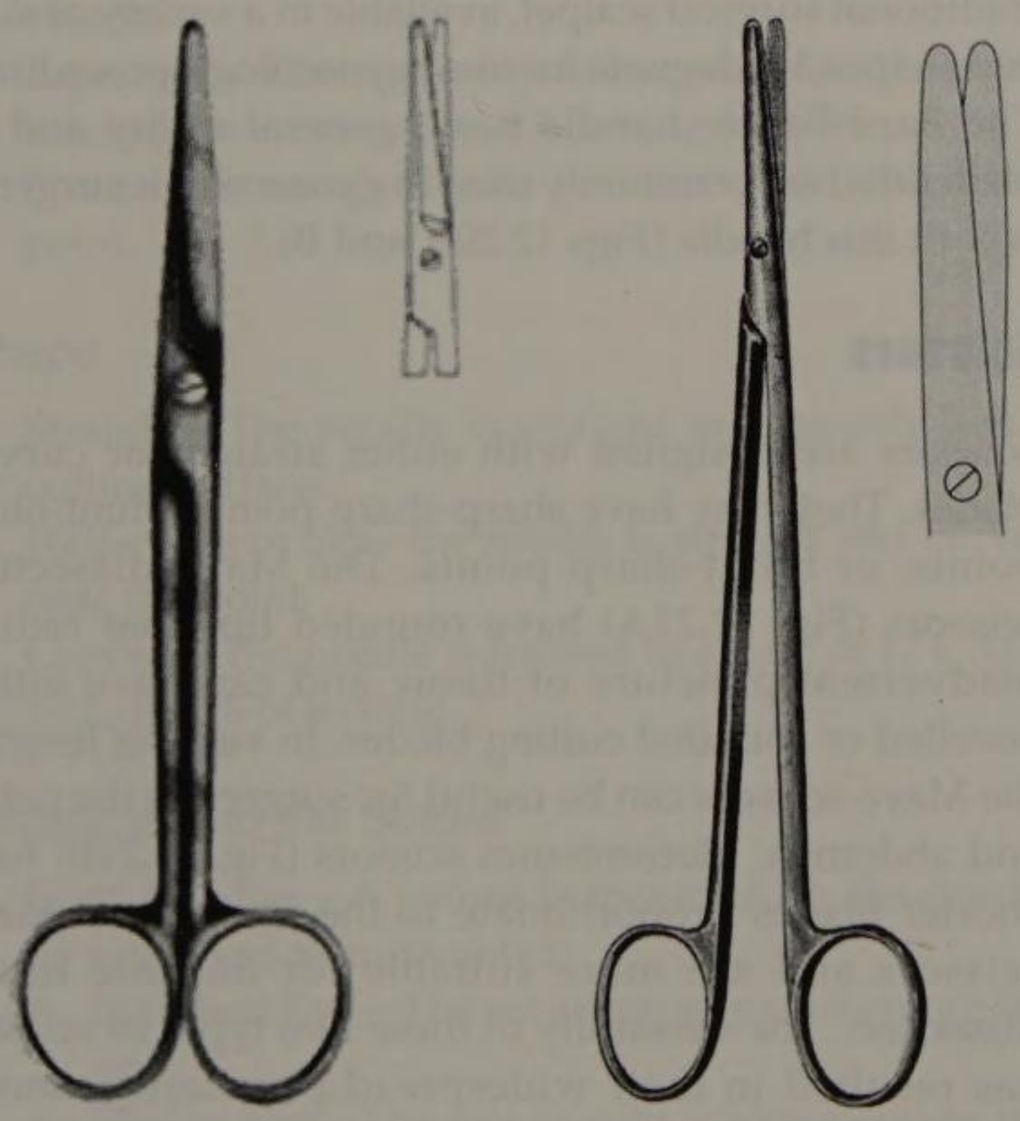
Scissors

Scissors are designed with either straight or curved blades. They may have sharp-sharp points, blunt-blunt points, or blunt-sharp points. The Mayo dissecting scissors (Fig. 12.21A) have rounded tips that reduce inadvertent puncture of tissue and can have either bevelled or rounded cutting blades. In varying lengths, the Mayo scissors can be useful for surgery in the pelvis and abdomen. Metzenbaum scissors (Fig. 12.21B) have shorter blades proportionate to the shafts than Mayo scissors and are more suitable for delicate tissue dissection. The versatility of these two types of scissors has resulted in their widespread popularity among gynecologists.

Other specially modified scissors have useful functions in gynaecologic surgery. Jorgenson scissors have very sharply curved blades than can be placed into the opened vagina and can circumferentially cut the vagina at the level of the vaginal fornices. Excision of



Figs 12.20A and B: (A) Scalpels, and (B) Bard Parker handles



Figs 12.21A and B: (A) Mayo's scissors, (B) Metzenbaum scissors

the cervix in this manner preserves vaginal length and provides a smoothly cut edge for easy suturing of the vaginal cuff.[1,2]

Grasping Forceps

The cervix and other parts of the uterus are grasped by using the classical Pozzi forceps (tenaculum or bullet forceps) (Fig. 12.22) and Museux forceps. Grasping the vaginal flaps requires specific toothed forceps. Most surgeon's preference are the Chrobak forceps and Gaston Cotte forceps. The teeth, at the extremities of these forceps, are mouse-like, which means that they cross each other giving the instrument great grasping strength. The Chrobak forceps are electively used for vaginal radical hysterectomy. The Gaston Cotte forceps, which are copies of the former but half the size, are the best instruments for tightening the vaginal flaps during reconstructive surgery. They are more powerful than Allis forceps (Fig. 12.23) that continue to be very useful in many steps of reconstructive surgery and deserve to be kept in the vaginal surgery box alongside the Chrobak and Gaston Cotte forceps.

Bipolar forceps (Fig. 12.24) function well as a hemostatic agent for small vessel bleeding. By applying pressure before passing current, one can ensure that the bleeding has been controlled with minimal damage to adjacent tissue.[3]

Cervical Dilators

There are three commonly used types of cervical dilators none of which have distinct advantages over the others beyond the surgeon's personal preference (Figs 12.25 to 12.27).

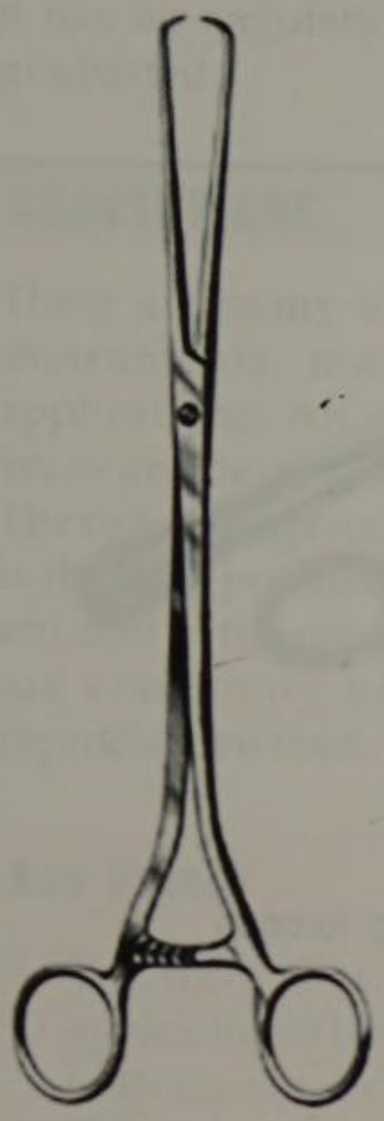


Fig. 12.22: Pozzi forceps (single tooth tenaculum)

Fig. 12.23: Allis forceps

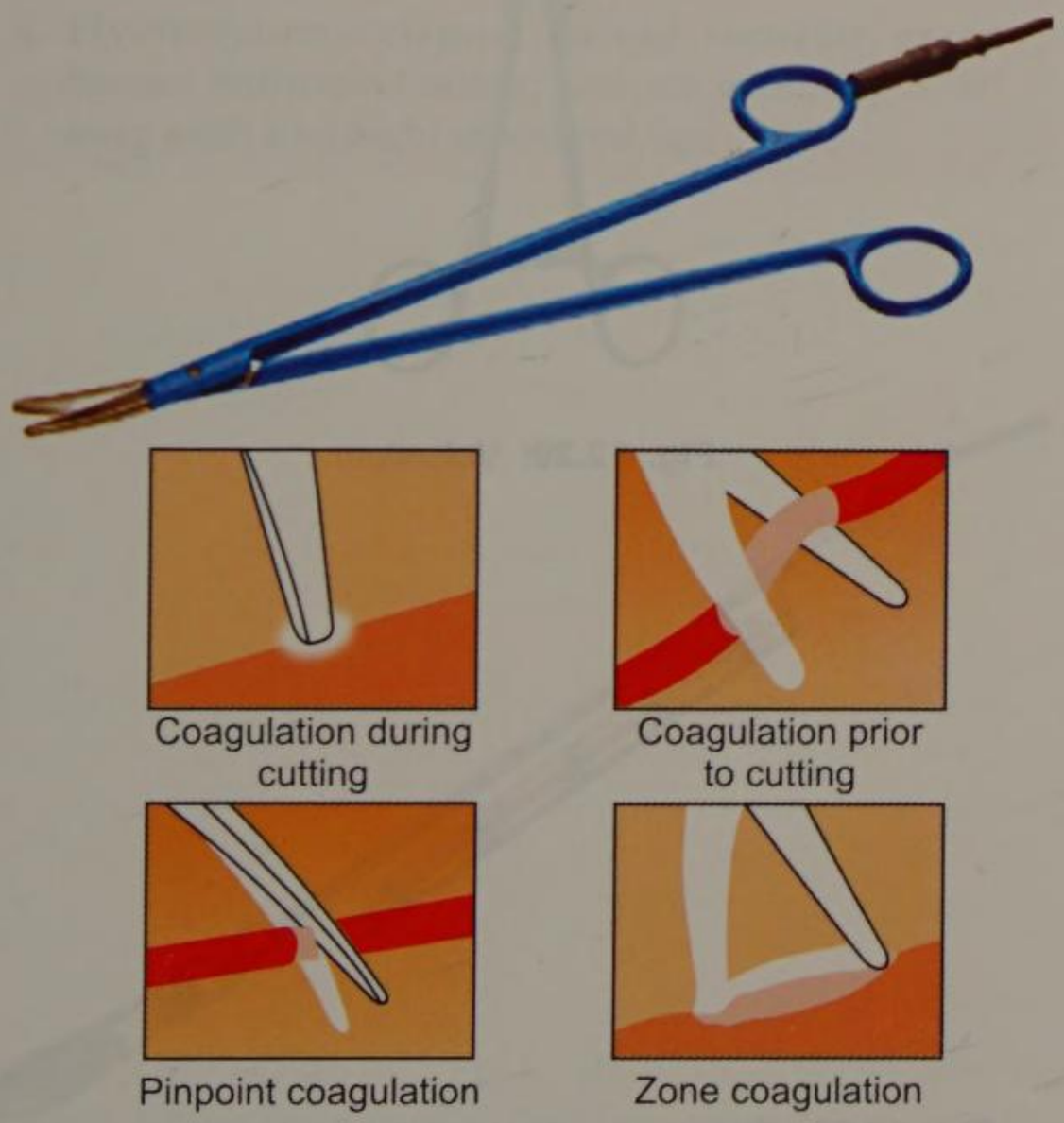


Fig. 12.24: Bipolar forceps

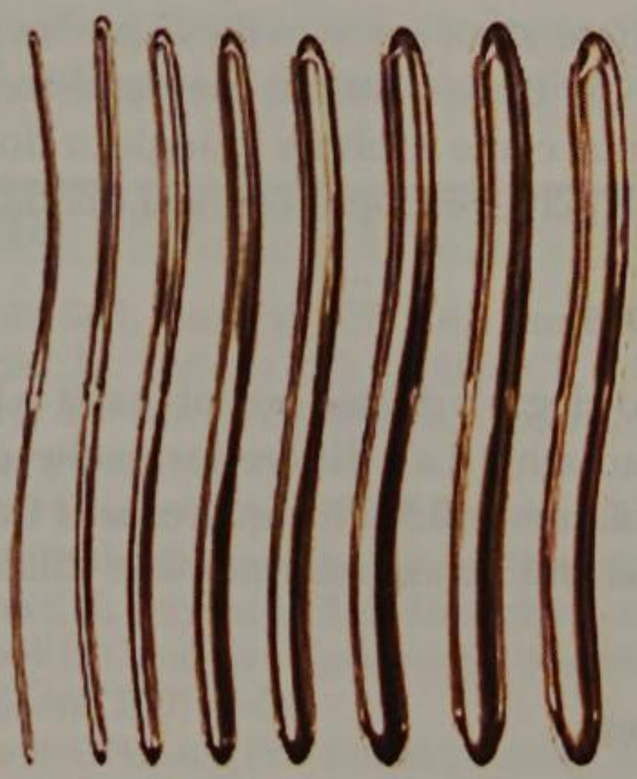


Fig. 12.25: Hegar dilators

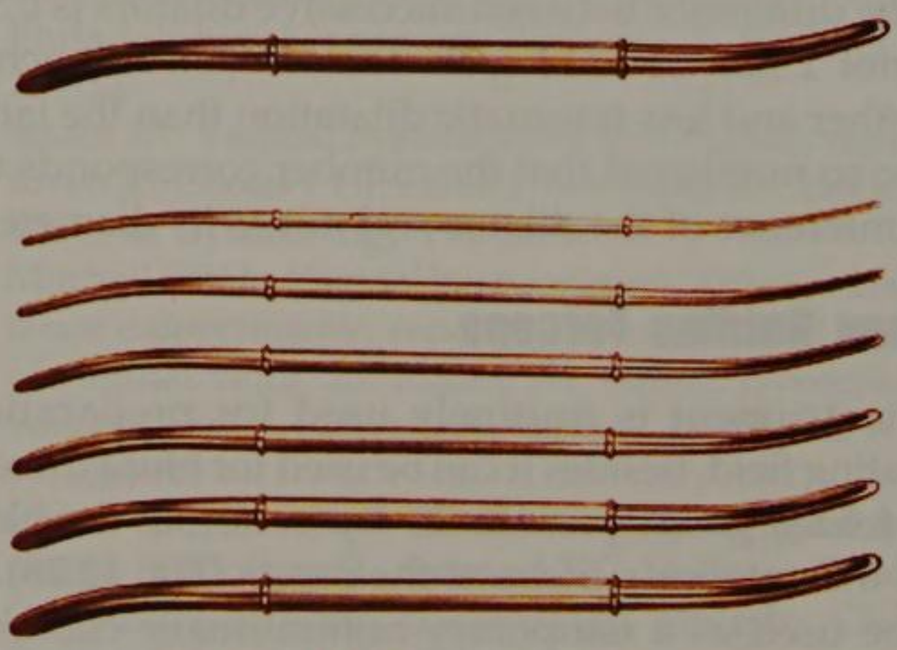


Fig. 12.26: Hank dilators

Fig. 12.27: Pratt dilators

Hegar Dilators

This is a solid rod curved and tapering towards the tip. There is a difference of 3 mm in the diameter near the tip and accordingly these dilations are numbered from 3/6 to 23/26. It may come as either a single or double ended instrument. It achieves rapid cervical dilatation.

Hank Dilators

It is similar to Hegar's dilator except that it is less curved. It is half graduated i.e., difference in the diameter of successive dilators is 0.5. This instrument thus achieves more gradual and hence less traumatic dilatation of the cervix.

Pratt Dilators

This is shaped like Hegar's dilator, but is half graduated, i.e., the difference between successive dilators is 0.5 mm and not 1 mm as in Hegars dilators. Thus, it achieves smoother and less traumatic dilatation than the latter. It is also so numbered that the number corresponds to the circumference of the dilator and not to its diameter.

Sponge Holding Forceps

The instrument is routinely used for preparation of operating field, besides it can be used for blunt dissection by a folded gauze piece as in separation of the bladder from the anterior surface of the cervix (Fig. 12.28). Also can be used as a temporary nontraumatic clamp over the ovarian vessels in the infundibulopelvic ligaments. Its ring shaped ends with transverse serrations provide better grip and prevents the sponge from slipping.[1,2]

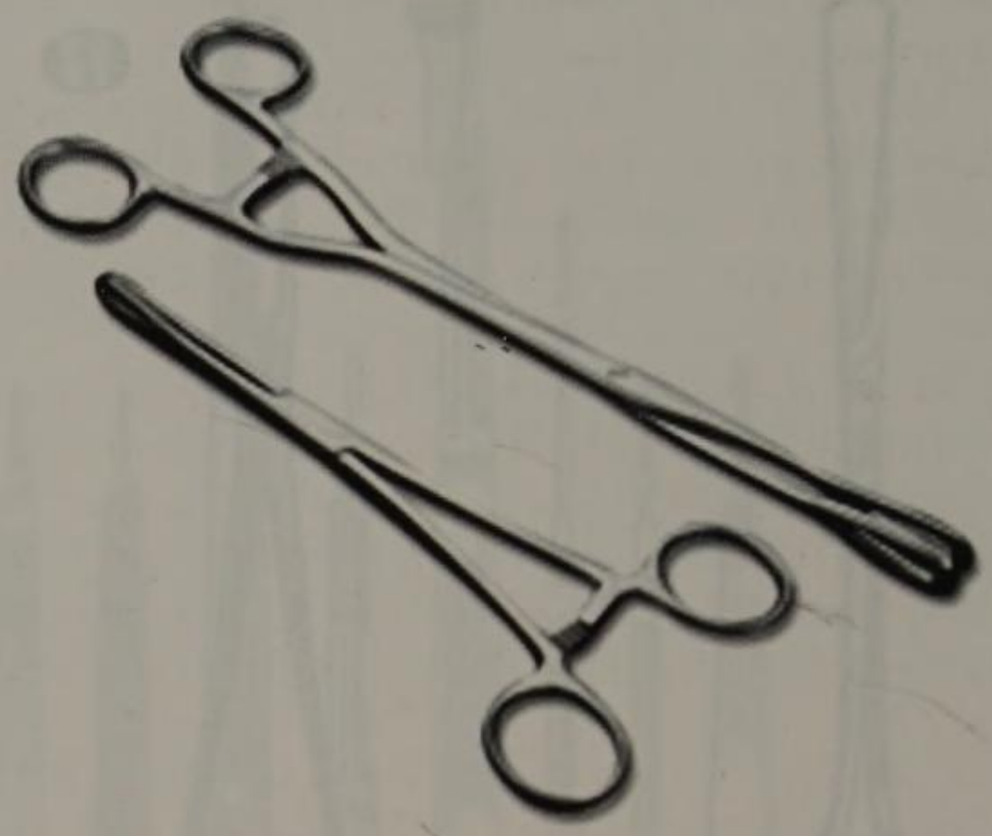


Fig. 12.28: Sponge holding forceps

Vulsellum

This instrument is 28 cm long with curved blades, which have 2 to 3 teeth (Fig. 12.29). The gentle curve in the blades ensures that the fingers do not obstruct the field of vision when the cervix is held during vaginal surgery.[6]

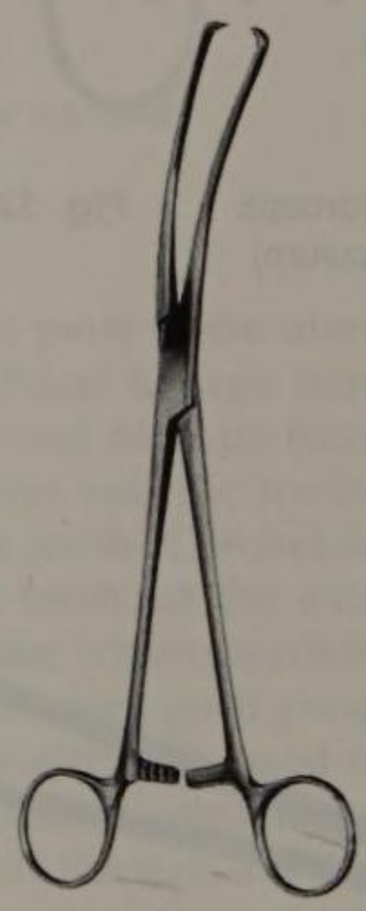


Fig. 12.29: Vulsellum

Simpson's Uterine Sound

It is a 30 cm long instrument bent to an angle of 150° at a distance of 2½ inches from its tip i.e., at a distance of normal uterocervical length (Fig. 12.30). Apart from 5 cm length of its handle, rest of it is graduated in inches or centimeters.

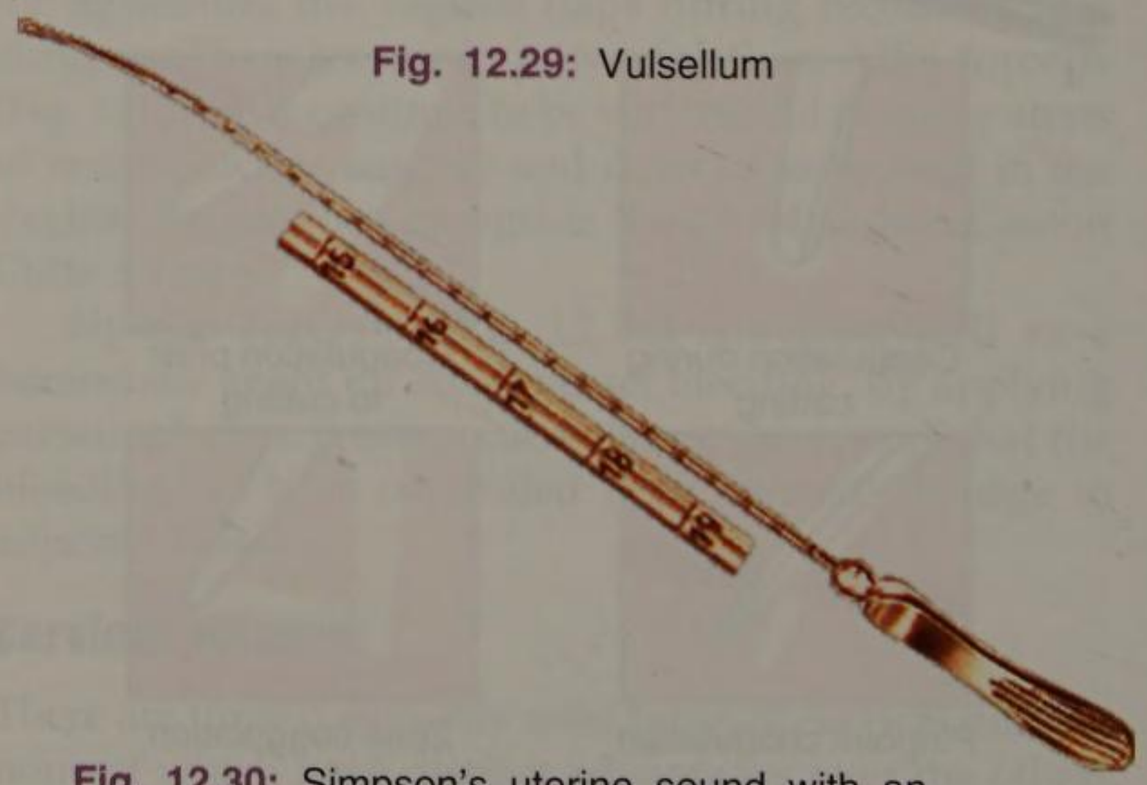


Fig. 12.30: Simpson's uterine sound with an angle of 150° at a distance of 2½ inch from tip (normal uterocervical length) and is graduated

Dittel's Bladder Sound

This instrument is 25 cm long which is curved in its terminal 5 cm. It differs from the anterior sound in that

it has no angulation but a smooth curve and it is not graduated.

CONCLUSIONS

There are many surgical catalogs with thousands of instruments, many of which have gynaecologic applications. An individual surgeon cannot possibly know and be proficient in the use of all these instruments. The redeeming fact, particularly in gynaecologic surgery, is that it is possible to become very knowledgeable and efficient in the use of a select number of instruments that are commonly used in the surgery of the female reproductive tract.

Key Points

1. The right choice of instruments will enable the gynecologist to accomplish any surgical technique with ease and efficiency.
2. Adequate illumination while working deep in the vagina may be provided by overhead lighting, spot lights and fibre-optic headlights.
3. Appropriate retractors are the key to successful vaginal surgery and must be selected to retract the tissues at the correct level without deepening the working area.
4. Hysterectomy clamps should securely grasp tissues without crushing and are generally 8"-9" long with a straight or curved tip.
5. Needle holders should be long, strong and preferably have a curved shank to enhance visibility of the tip and facilitate driving the needle in a tight curve or inaccessible position.

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Section III

Anesthesia, Blood Transfusion and Sterilization Techniques

13 Anesthetic Considerations for Vaginal Surgery

Ashok Kumar Saxena, Raman Azad, Nitin Jain

Common vaginal surgeries include vaginal hysterectomy with or without anterior colporraphy and colpoperineorraphy, non-descent vaginal hysterectomy, laparascopy assisted vaginal hysterectomy, Bartholin cyst excision, vaginal septum excision, vaginal cystectomy, vaginal myomectomy and hysteroscopy.

When planning regional anesthesia for vaginal operations, the somatic and autonomic innervation of the organ system must be considered. The dermatomal level required for the block of the autonomic and somatic innervation is shown in Figure 13.1.

Afferent impulses from the dome of the uterus require block to the T-10 dermatomal level. Nerves from the aortic plexus to at least as high as the T-10 level innervate the gonads. A dense block to at least the T-10 level is required for operations on the ovaries. For a block of the autonomic and somatic innervation, a block to the T-4 level is required for operations on the uterus (taking into considerations the peritoneal manipulation also). In the vaginal approach for hysterectomy, a dense block to at least T-10 level is more than sufficient for the regional anesthetic technique aiming for optimum intraoperative analgesia.

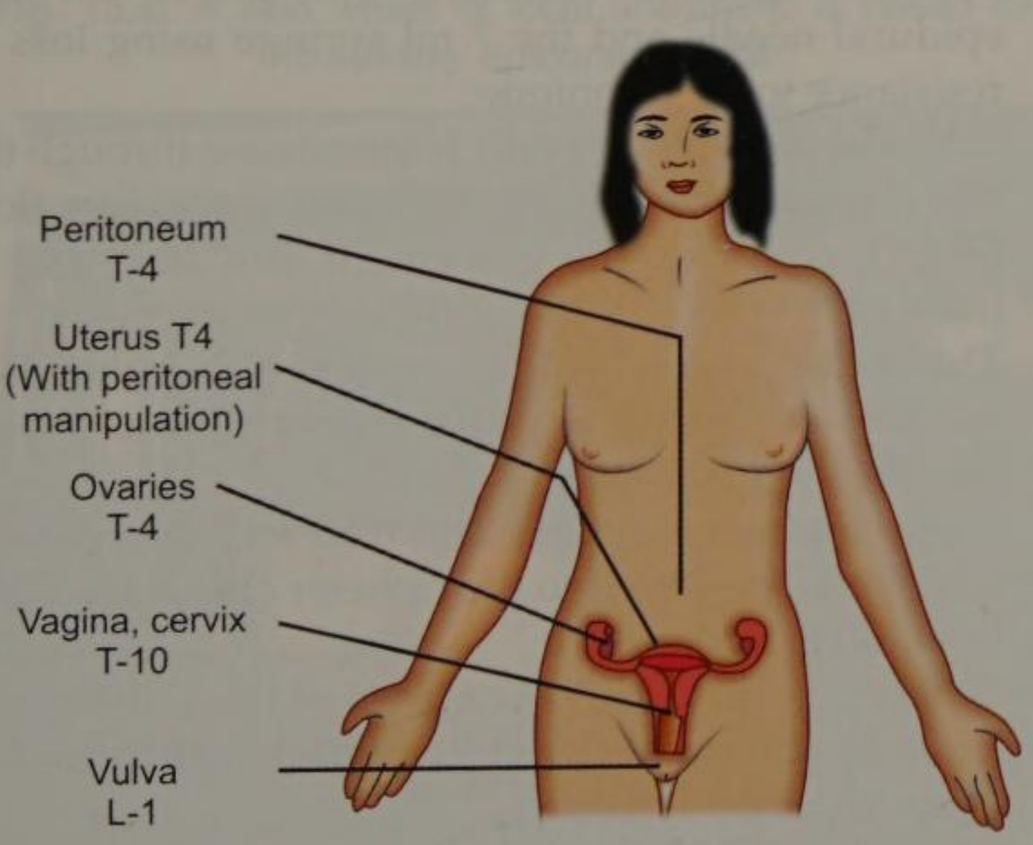

Fig. 13.1: Dermatomal levels required for a block of the autonomic and somatic innervation in the female

Rationale for using Regional Anesthesia

Vaginal operations are advantageously performed with regional anesthesia. The major advantages of regional anesthesia are:

1. Decreased blood loss.
2. Decreased transfusion requirements.
3. Improved intraoperative and postoperative pain control.
4. Decreased length of hospital stay.
5. Decreased incidence of postoperative emesis.
6. Decreased incidence of postoperative deep venous thrombosis.

The proposed mechanisms for decreased intraoperative blood loss when regional anesthesia is used include lower mean arterial blood pressure; spontaneous ventilation instead of intermittent positive pressure ventilation, resulting in lower intra-thoracic and therefore, pelvic venous pressures; haemodilution from volume loading before administration of regional anesthesia; and venous pooling and decreased venous tone in sympathectomised capacitance blood vessels, resulting in diminished venous blood and venous pressure available for loss.

Neuraxial Blocks for Vaginal Surgeries

Neuraxial block refers to block of the spinal cord nerve roots by subarachnoid, epidural or combined spinal-

epidural approach. There are various advantages and disadvantages of each of these techniques. But the prominent factors to consider are the dermatomal extent of block required for the procedure, the duration of the procedure, the intraoperative positioning of the patient, the need for postoperative neuraxial analgesia, and the patient's coexisting medical conditions. The combined spinal-epidural technique basically considers all these prominent factors and hence, is the regional technique of choice for vaginal operations.

In authors' experience, combined spinal-epidural block has been found to be the regional anaesthetic technique of choice for providing optimum intra-operative and postoperative pain relief. A written informed consent is definitely required for neuraxial block; but occasionally patients demand combined epidural and general anesthesia followed by epidural administration of local anaesthetic and/or opioids.

Equipment Required

1. Routine epidural tray with gauze pieces, betadine and sponge holder, etc.
2. Combined spinal-epidural kit
   This includes:
   i. The 18-G × 3½ (1.2 × 90 mm) Weiss epidural needle
   ii. The 27-G × 6 (0.4 × 150 mm) Whitacre spinal needle
   iii. The 20-G (0.9 mm) Polyamide closed-end epidural catheter with introducer guide
   iv. The 7 ml LUER-SLIP "EPILOR" syringe
   v. Catheter connector
   vi. The 0.2 μ epidural filter.

Basic Essential Monitoring under Combined Spinal-epidural

This includes continuous ECG, heart rate, non-invasive BP and oxygen saturation.

Position of Patient for Combined Spinal-Epidural

Sitting position (with pillow in the lap) and patient bent forward (Fig. 13.2); occasionally a lateral position.

Pre-Loading

Following intravenous pre-loading with Ringer's lactate/3.5% gelatin/6% hydroxyethyl starch (500 ml), the combined spinal-epidural block is planned.

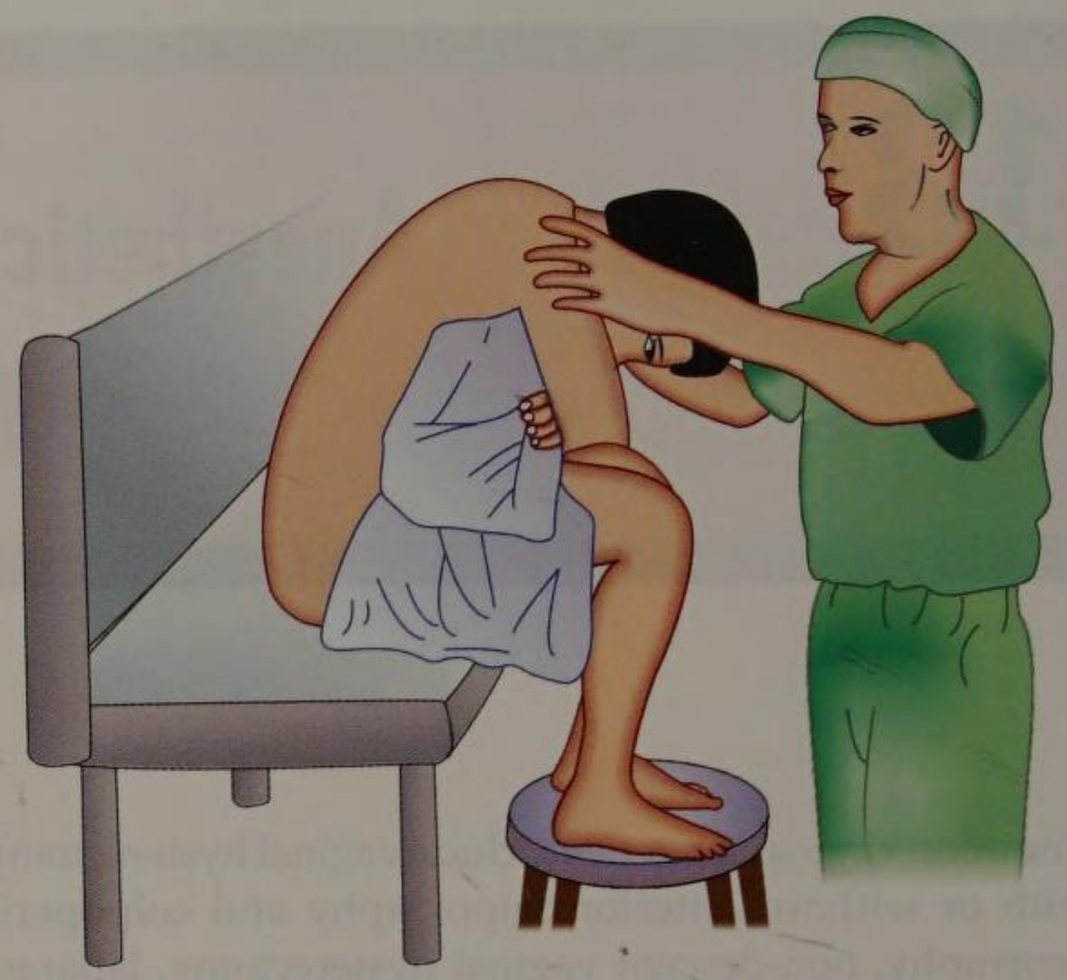

Fig. 13.2: Sitting position for combined spinal-epidural anesthesia

Steps for Combined Spinal-Epidural Anesthesia (Figs 13.3 to 13.11)

1. Informed consent is taken from the patient.
2. Patient is put in sitting position or lateral position and taking all aseptic precautions, area from inferior angle of scapula to the posterior–superior iliac spines is cleaned and draped.
3. Local anesthetic infiltration of skin, subcutaneous tissues, supraspinous ligament, interspinous ligament and ligamentum flavum with 2% lignocaine is carried out in the L3-L4 space.
4. Epidural space is identified with the 18-G Weiss epidural needle and the 7 ml syringe using loss of resistance to air technique.
5. The Whitacre spinal needle is introduced through the Weiss needle into the subarachnoid space. Free flow of CSF confirms the placement and the drug is injected.
6. The spinal needle is then removed and the 20-G epidural catheter is threaded through Weiss needle into the epidural space.
7. Weiss epidural needle is removed and the epidural catheter is connected to the catheter connector along with the filter.
8. Betadine soaked gauze is placed at the catheter site and the catheter is secured on the back with dynaplast or micropore.

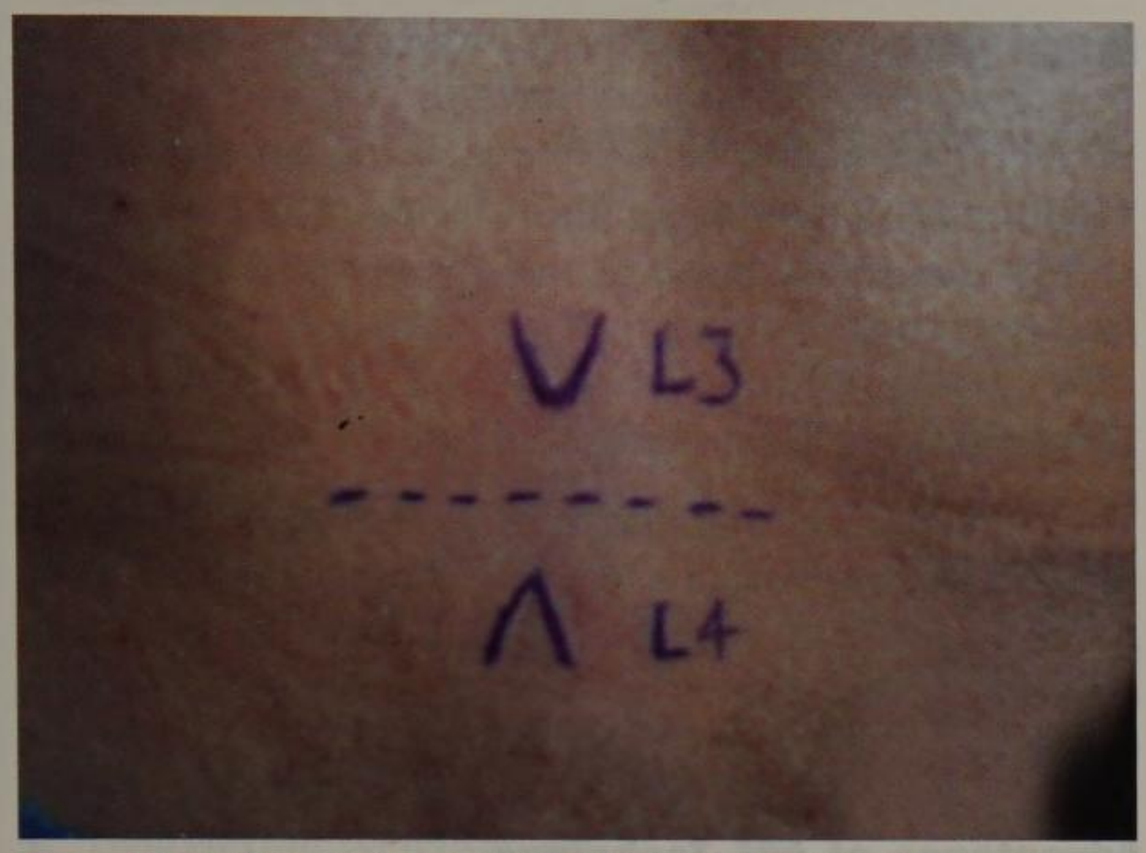

Fig. 13.3: Anatomical landmark: L3-L4 interspinous space, midline approach for combined spinal epidural anesthesia

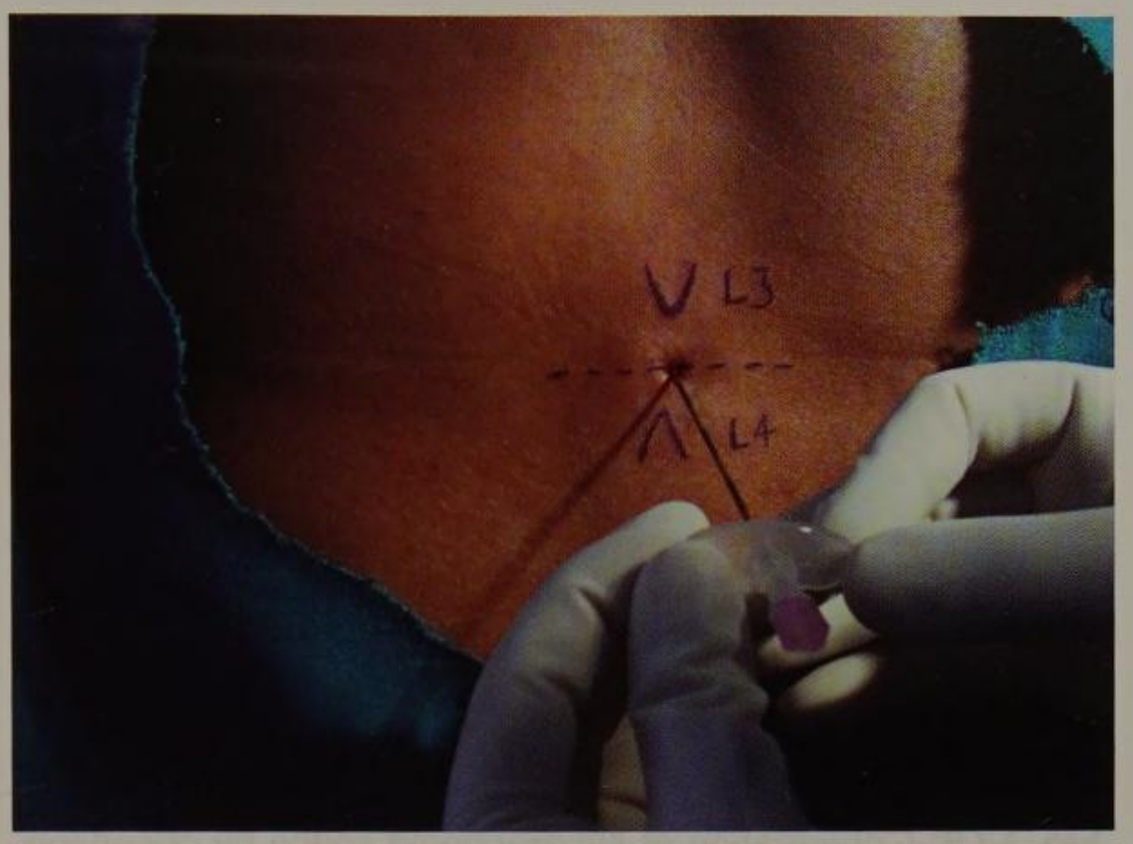

Fig. 13.6: Epidural needle being inserted in L3-L4 interspace

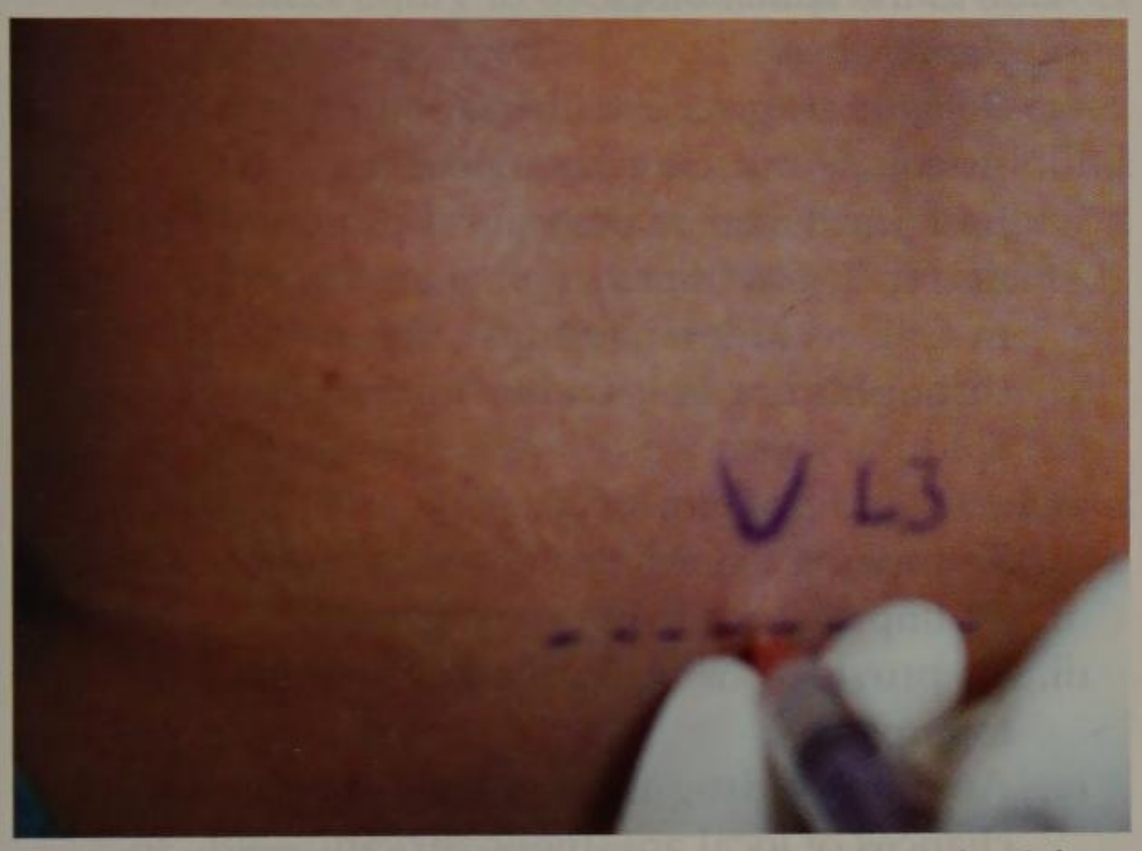

Fig. 13.4: A skin wheal of local anesthetic is raised for introducing epidural needle

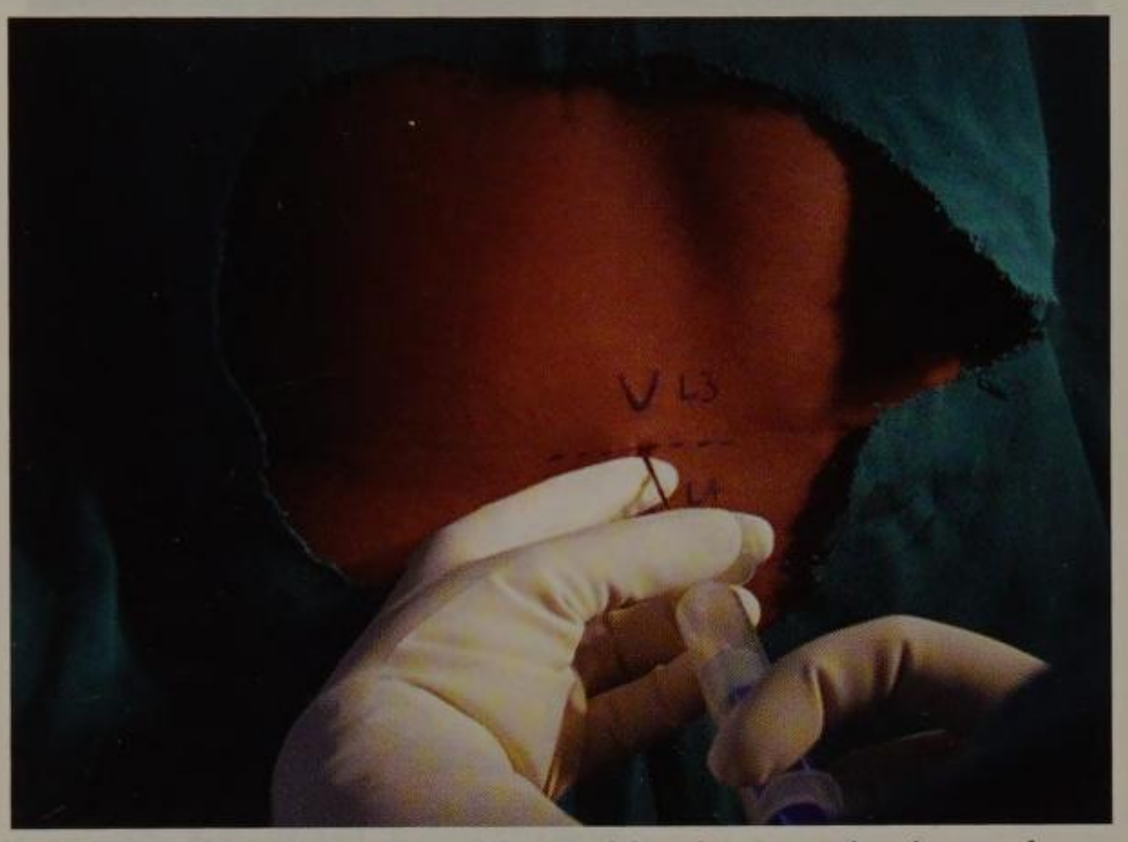

Fig. 13.7: Identifying the epidural space by loss of resistance technique

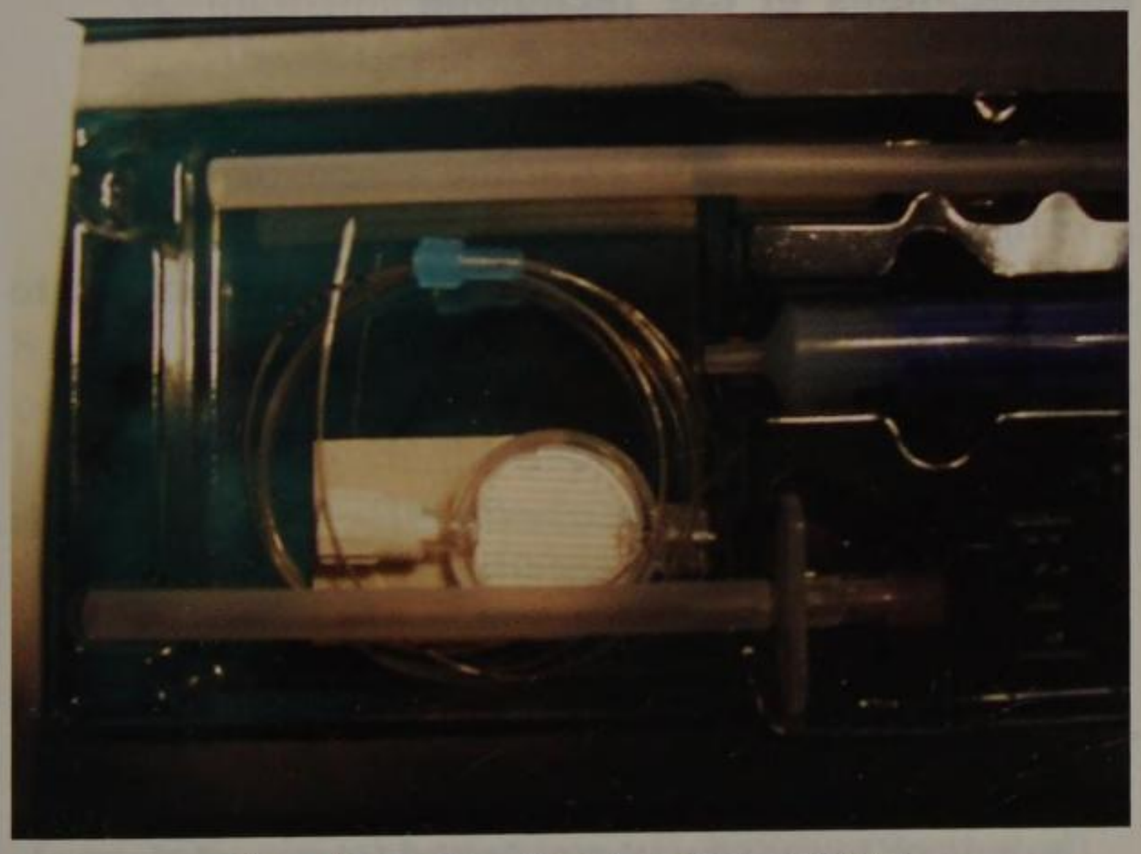

Fig. 13.5: Combined spinal epidural anesthesia kit

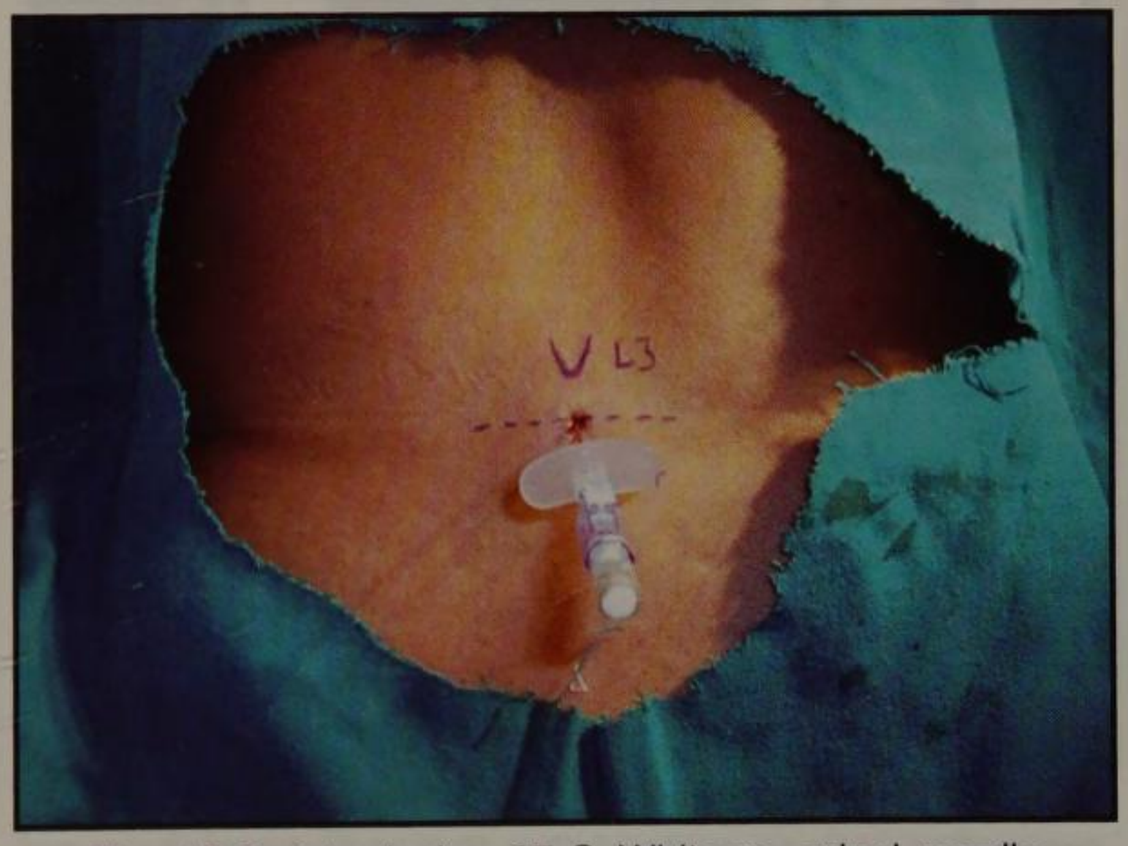

Fig. 13.8: Introducing 27-G Whitacre spinal needle through 18-G Weiss epidural needle

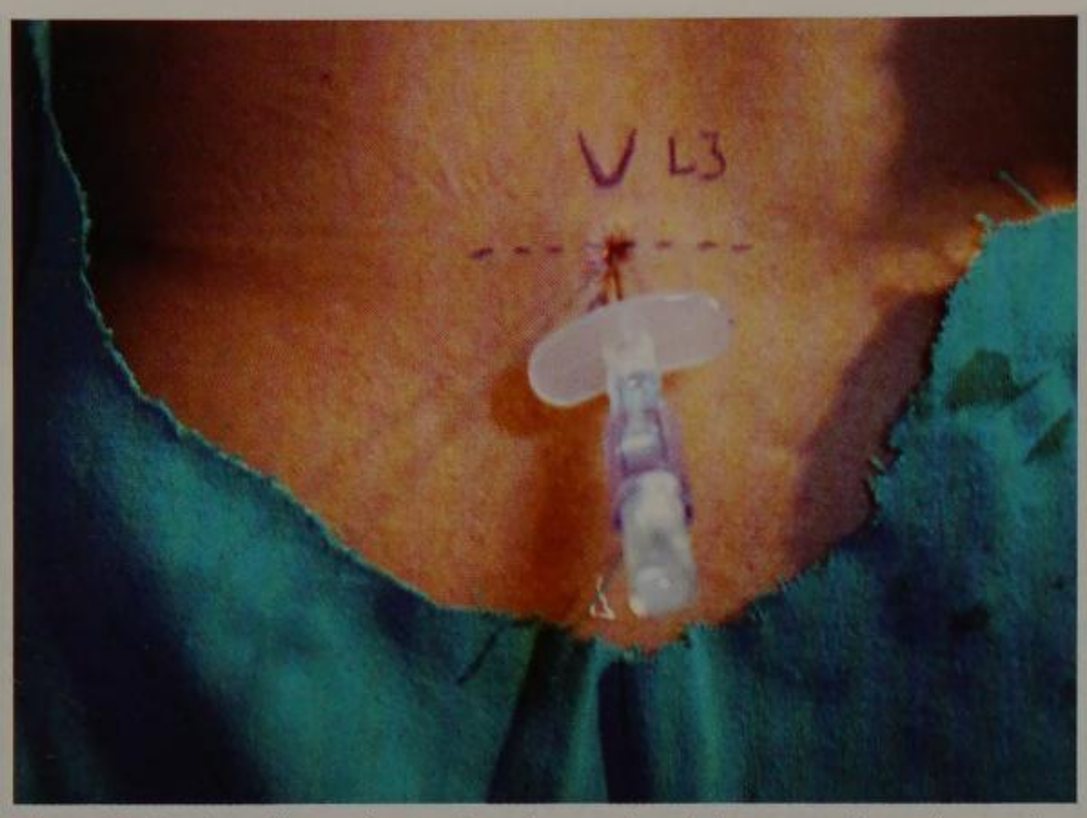

Fig. 13.9: Confirmation of subarachnoid space by observing free flow of CSF through 27-G Whitacre spinal needle

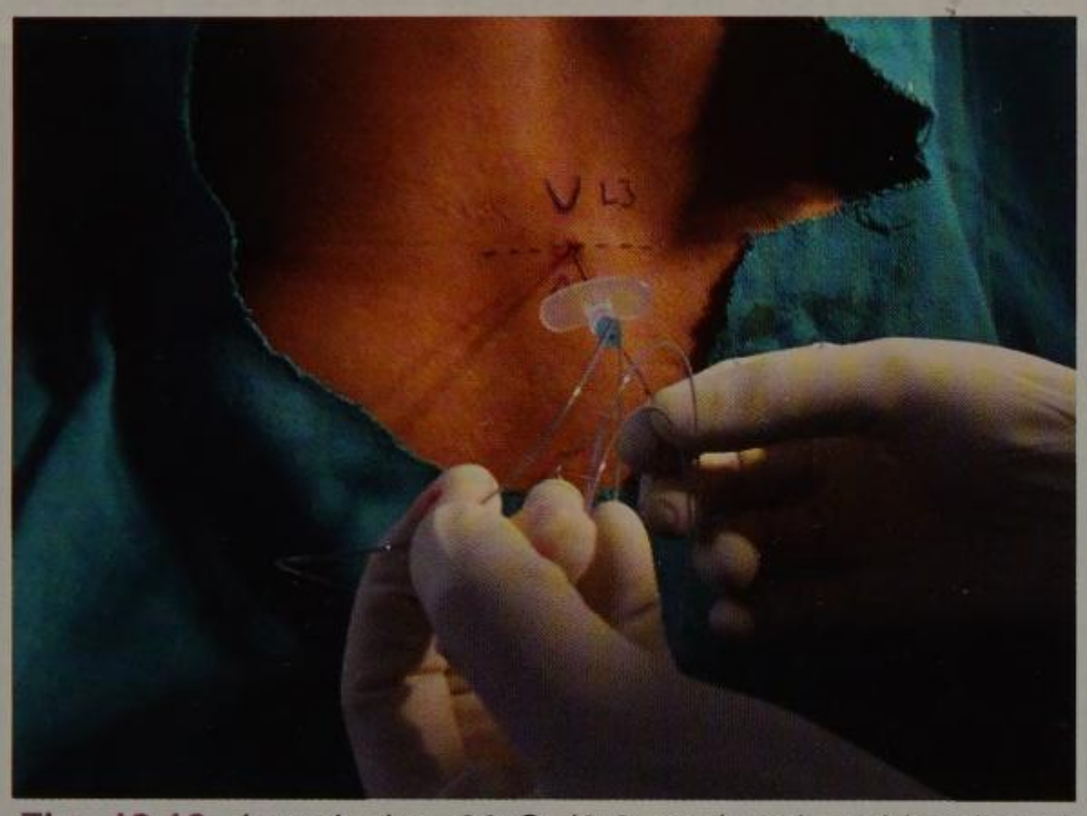

Fig. 13.10: Introducing 20-G (0.9 mm) polyamide closed end epidural catheter into the epidural space

Fig. 13.11: Completion of epidural catheter assembly with connection onto an epidural filter (0.2 μ) and a final proper fixation of epidural catheter at the back

Drugs Used

Subarachnoid Anesthesia

2.5 ml of 0.5% hyperbaric bupivacaine (12.5 mg)/1.5 ml of 0.5% hyperbaric bupivacaine (7.5 mg) plus 25-30 μg of fentanyl.

Postoperative Pain Relief

Through epidural catheter, top-ups are provided by 0.25 to 0.375% of bupivacaine (6-8 ml) 6 hourly for the first 48 hours and then 12 hourly at 48-72 hours subject to pain assessment utilizing visual analogue score of 4 cm and above.

Advantages of CSE Technique

1. Due to the spinal block:
   i. Rapid onset.
   ii. Reliable surgical anesthesia.
   iii. Adequate muscle relaxation.
   iv. Less incidence of post dural puncture headache due to 27-G Whitacre spinal needle which is used in CSE technique and also the risk of CSF leak through dura is less due to the pressure in the epidural space.
2. Due to epidural block:
   i. To prolong the duration of anesthesia.
   ii. To improve inadequate spinal block.
   iii. To provide postoperative pain relief by epidural top ups.
   iv. Amount of drug used is less and therefore, less chances of local anesthetic toxicity.

Complications of CSE Technique

Immediate

1. Hypotension and bradycardia.
2. High spinal block.
3. Catheter migration through the dural hole leading to total spinal anesthesia.

Delayed

1. *Post-dural puncture headache (PDPH)*: The incidence is dramatically lower with the use of a Whitacre (27-G/29-G) spinal needle (1.1%). Headache is occasionally associated with diplopia, tinnitus and nausea and vomiting (Hurley et al).
2. PDPH usually resolves spontaneously in a few days to a week for most patients. Initial treatment is simple bedrest and analgesics. Caffeine has been shown to

produce short-term symptomatic relief. Epidural blood patch is alternative for patients, who are unwilling to await spontaneous resolution of PDPH. Ten to 20 ml of autologous blood is aseptically removed and injected into the epidural space at or near the interspace at which the meningeal puncture occurred. It is effective within 1-24 hours in 85-95% of patients. Epidurally administered fibrin glue has also been shown to be an effective alternative in PDPH.

3. *Backache*: Etiology of backache is not clear, although needle trauma, local anesthetic irritation, and ligamentous strain secondary to muscle relaxation have been offered as explanations.
4. *Neurological complications:*
   a. Cord damage due to:
      i. Direct injury to the spinal cord or nerve roots caused by needle or catheter (cauda equina syndrome—1.2:10,000)(Auroy et al), 2 cases reported with combined spinal and epidural block using bupivacaine, (Kubina et al)].
      ii. Toxicity caused by local anaesthetic agents.
   b. *Cord ischaemia*: very-very rare
      i. Anterior spinal artery syndrome.
   c. *Cord compression*: very-very rare.
   d. Haematoma (1:200,000 for spinal anesthesia and 1:142,000 for epidural anesthesia as reported by Renk's review), caused by:
      i. Needle trauma.
      ii. Vascular anomaly.
      iii. Spinal tumour.
      iv. Bleeding disorder.
      v. Anticoagulant drugs.
      vi. Idiopathic.
      vii. Abscess (epidural abscess 0.002-0.012%) (Baker et al).
      viii. Exogenous infections via needle (1.2:100,000).
      ix. Haematogenous.

   Early detection is crucial since the delay of more than 8 hours in decompressing the spinal cord reduces the odds of good recovery. Patients receiving fractionated low molecular-weight heparin (e.g. enoxaprin) are considered to be at increased risk of spinal haematoma.
   e. Arachnoiditis (1:10000-25000) (Parnass et al).
   f. Meningitis: very-very rare.
      i. Exogenous.
      ii. Endogenous.
      iii. Aseptic.
   g. Intracranial haematoma (1:500000) (Scott et al).

Contraindications

As for any regional anesthesia:

1. Patient refusing consent.
2. Coagulopathies.
3. Back pain and back surgeries.
4. Infection at the local site.
5. Increased intracranial pressure.

If due to financial constraints, it is not possible to procure a CSE set, then a simple subarachnoid block using a pencil point spinal needle is sufficient as an anesthetic technique for vaginal surgeries of duration of 1.5 to 2 hours. Analgesia could be prolonged by addition of opioids such as intrathecal fentanyl (25-30 μg) to the local anesthetic injected in subarachnoid space.

CSEA has the advantage that "spinal anesthesia component" produces more rapid-onset of better-quality sensorimotor block with excellent intraoperative analgesia and the "epidural anesthesia component" has the ability to extend the block intraoperatively using an indwelling catheter, with the option of providing optimum postoperative sensory analgesia for another 48-72 hours in the postoperative period. These regional blocks are effective in minimising the hospital stay for the patients undergoing vaginal surgery. Hence, with the help of these regional blocks, patients can be ambulatory at just 24 hours postoperatively, experience minimum postoperative anesthetic complications and are ready for an early discharge from the hospital.

Other Regional Techniques

Caudal Epidural Anesthesia

Caudal epidural block can be used as a substitute of neuraxial anesthesia in patients having spinal abnormalities or persistent back pain. The caudal epidural space is the lowest portion of the epidural system and is entered through the sacral hiatus. The sacrum is a triangular bone that consists of the five fused sacral vertebrae (S1-S5). It articulates with the fifth lumber vertebra and the coccyx. The sacral hiatus is a defect in the lower part of the posterior wall of the sacrum formed by the failure of the laminae of S5 and/or S4 to meet and fuse in the midline (Fig. 13.12). There is a considerable variation in the anatomy of the tissues near the sacral hiatus, in particular, the bony sacrum. The sacral canal is a continuation of the lumbar spinal canal, which terminates at the sacral hiatus. As many as 7% patients lack a patent sacral hiatus, the typical entry site for caudal anesthesia.

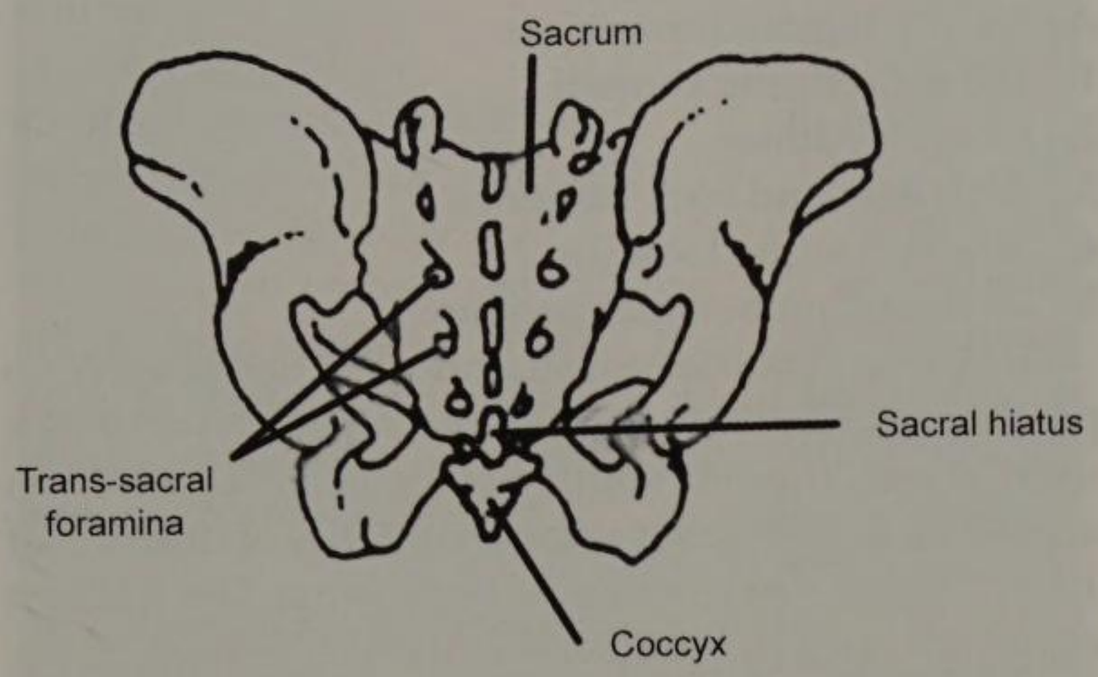

Fig. 13.12: Anterior view of pelvis showing the sacral hiatus

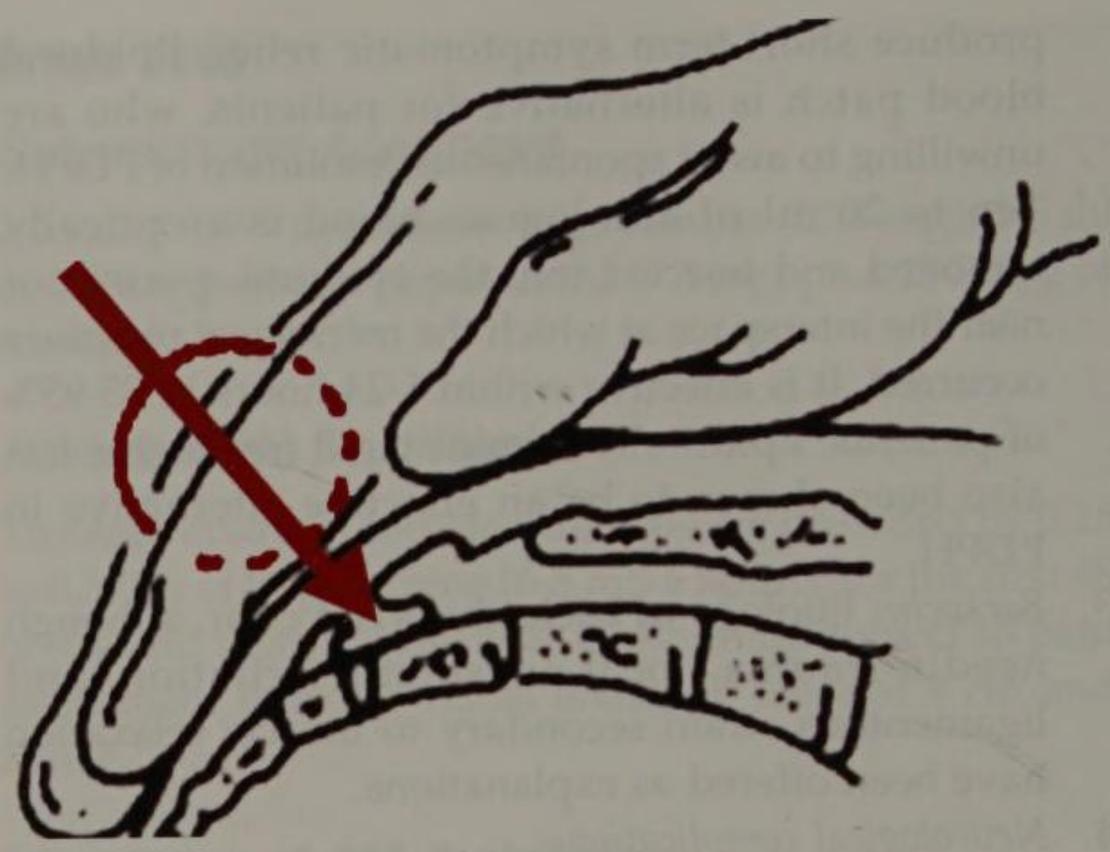

Fig. 13.13: Caudal technique. Palpating fingers locate the sacral cornua

The sacral hiatus can be located by first palpating the coccyx, and then sliding the palpating finger in a cephalad direction (towards the head) until a depression in the skin is felt. (In an adult the distance from the tip of the coccyx to the sacral hiatus is approximately the same as the distance from the tip of their index finger to their proximal inter phalangeal joint (Fig. 13.13).

Once the sacral hiatus is identified the area above is carefully cleaned with antiseptic solution, and a 22 gauge short bevelled cannula or needle is directed at about 45° to skin and inserted till a "click" is felt as the sacro-coccygeal membrane is pierced. The needle is then carefully directed in a cephalad direction at an angle approaching the long axis of the spinal canal (Fig. 13.14). Another point to successful identification of caudal epidural space is "whoosh" test. This consists of characteristic noise auscultated in the thoracolumbar region when 2 to 3 ml of air is inserted into the caudal epidural space. The predictive value of a positive and a negative result of the whoosh test is almost 100%.

Caudal block is an easy and safe technique, which can be used to provide intra-operative anesthesia and postoperative analgesia (using 10-12ml of 0.375% bupivacaine) for a wide range of vaginal surgical procedures. When performed carefully complications are rare.

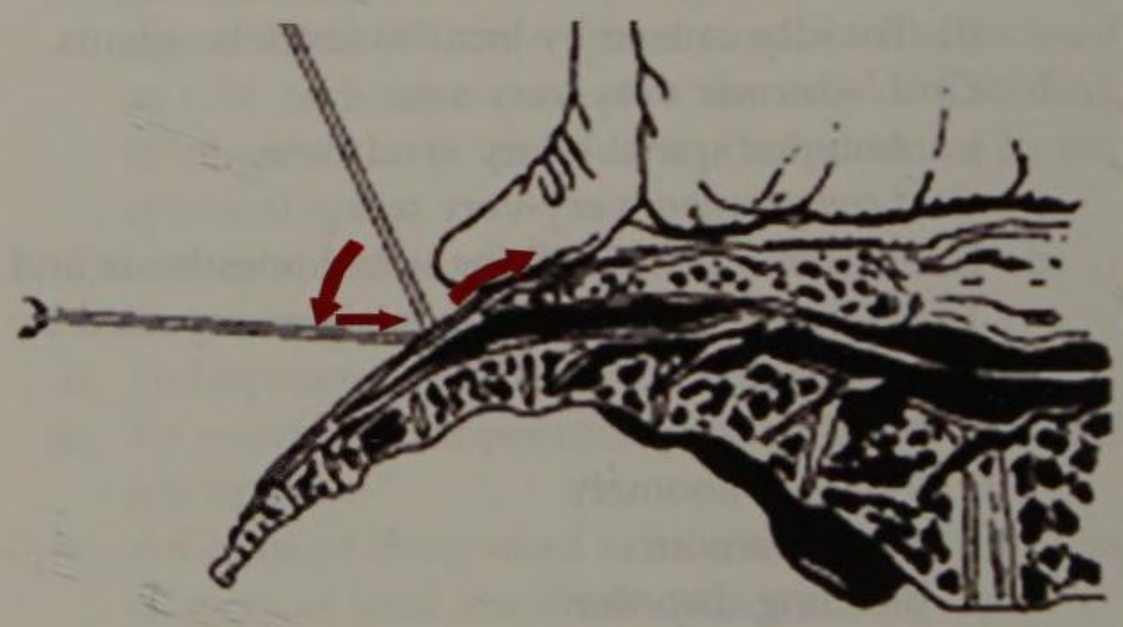

Fig. 13.14: Caudal technique. Needle insertion is carried out by insertion and withdrawal in a stepwise fashion

Pudendal Nerve Block

Pudendal nerve block can be used for superficial vaginal surgeries like vaginal cyst (excision), vulval biopsy, cervical cerclage, marsupialzation of bartholin duct cysts, etc.

The pudendal nerve (S2-S4) is the major sensory innervation of the lower one-third of vagina, posterior two-third of vulva and perineum and provides motor fibres to the external anal sphincter and the perineal muscles. It lies close to the internal pudendal artery and posterior to the sacrospinous ligament (Fig. 13.15).

Pudendal nerve blocks are usually approached transvaginally, although a transperineal approach has been described (Figs 13.16 and 13.17). Since it is a nonvisualised needle puncture in an area susceptible to unintentional needle placement into adjacent organs, a shielded needle (Iowa trumpet or Kobak needle guide) is used to prevent injury to rectum, bladder, bowel, uterine artery and foetus (relevant to labor analgesia).

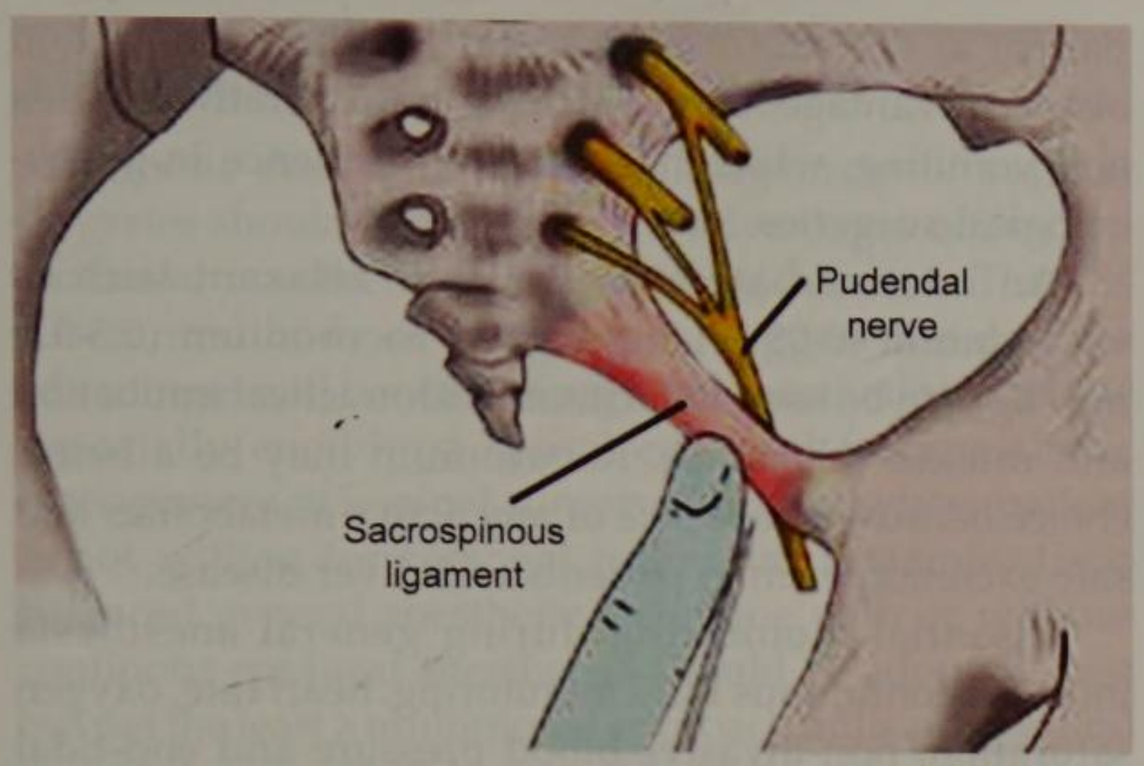

Fig. 13.15: Anterior view of sacrum showing pudendal nerve in relation to sacrospinous ligament

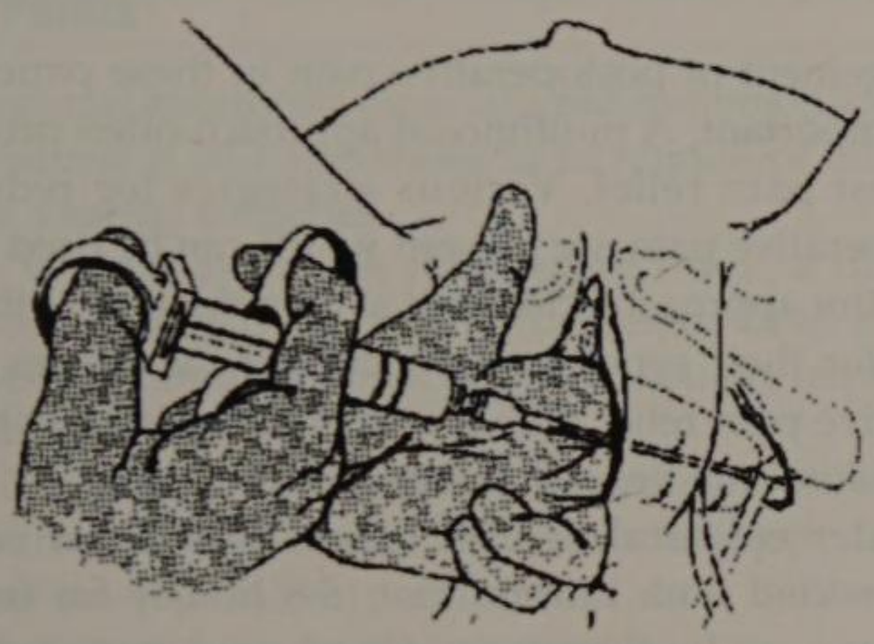

Fig. 13.16: Transvaginal approach for pudendal nerve block

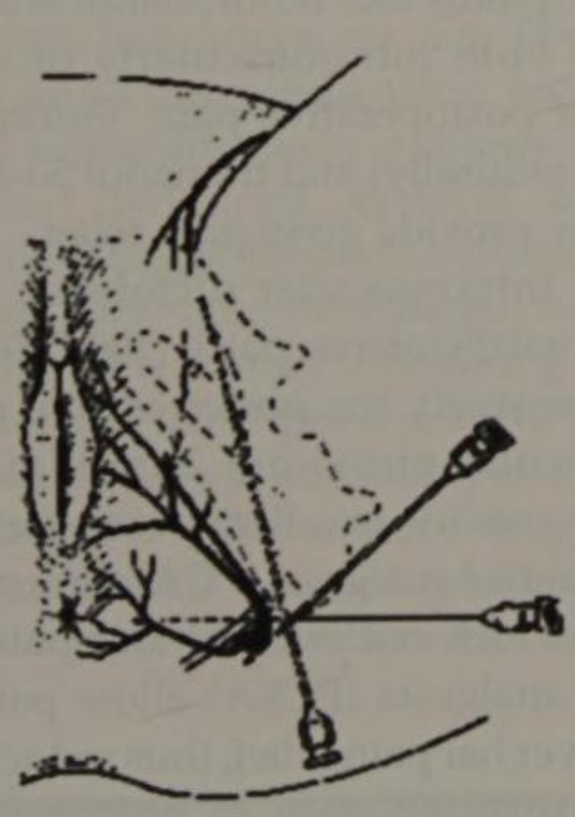

Fig. 13.17: Transperineal approach for pudendal nerve block

The palpating finger is used to locate the ischial spine and sacrospinous ligament per vaginum. The needle is introduced through the vaginal mucosa and sacrospinous ligament, just medial and posterior to the ischial spine. The sacrospinous ligament causes considerable resistance as the needle passes through it. As soon as the needle has passed through the sacrospinous ligament, a loss of resistance is felt. At this point 7-10 ml of local anesthetic solution (e.g. 1% lignocaine with adrenaline) is injected after careful aspiration as pudendal artery lies in close proximity to pudendal nerve.

Use of concentrated solution of local anesthetic is not recommended as rapid maternal absorption of local anesthetic occurs after the performance of pudendal nerve block. Addition of epinephrine to local anesthetic solution improves the quality of pudendal nerve block. Leg strength should always be assessed before the patient is transferred.

Complications

Maternal

1. Laceration of vaginal mucosa.
2. Systemic local anesthetic toxicity.
3. Vaginal and ischiorectal haematoma.
4. Retropsoas and subgluteal abscess.

Foetal (relevant to labor analgesia)

1. Foetal trauma.
2. Direct foetal injection of local anesthetic.

Perineal Infiltration

It is often used in conjunction with pudendal nerve blocks or in cases of unsatisfactory epidural anesthesia. It provides good anesthesia for episiotomies and repair. However, it has one major disadvantage in that it does not provide muscle relaxation.

Complications

- Injection of local anesthetic into the foetal scalp.
- Few cases of neonatal lidocaine toxicity have been reported.

Local Anesthesia with Sedation

Local anesthesia with sedation has been used for superficial vaginal surgeries. Recently its use has become popular for more invasive vaginal reconstructive surgeries like anterior and posterior colporrhaphies,

colpocleisis, etc. The advantages of local anesthesia include minimal interference with homeostasis and rapid recovery with patients often bypassing the recovery unit. {Buchsbaum, 2006}

GENERAL ANESTHESIA FOR VAGINAL SURGERIES

Patient's refusal of regional anesthesia is the most important factor for providing general anesthesia for vaginal surgeries. The technique involved is balanced to provide optimum analgesia, hypnosis, muscle relaxation and amnesia.

Under these circumstances, a standardised general anaesthetic technique (Fig. 13.18) consisting of propofol induction, muscle-relaxant and inhalational agents-low concentration with basic minimum monitoring can be planned after a detailed pre-anaesthetic check-up and adequate premedication advice with oral benzodiazepines and perioperative opioid (intravenous morphine (0.1 mg/kg)/fentanyl (1-2 mg/kg) medication). Benzodiazepines such as alprazolam and diazepam serve as good premedicating agents. They have both anxiolytic and amnestic properties. Oral diazepam 10mg on night before surgery and 10 mg on morning of surgery keeps the patient calm and anxiety free.

Propofol (1.0-2.5 mg/kg) is the preferred induction agent of choice due to the clear-headed recovery of the patient at the end of anesthesia. Its antiemetic action also is advantageous in reducing postoperative nausea and vomiting, which has a higher incidence in gynaecological surgeries.

Fig. 13.18: Equipments and drugs used in general anesthesia for vaginal surgery. Ringer's lactate, laryngoscope, endotracheal tube, guedel's airway, laryngeal mask airway, Magill forceps, propofol, thiopentone, ketamine, midazolam, succinylcholine, vecouronium, rocuronium, neostigmine, glycopyrolate, fentanyl, morphine

An intermediate acting muscle relaxant such as vecuronium (0.05-0.1 mg/kg) or rocuronium (0.3-1.0 mg/kg) can be used to facilitate endotracheal intubation and muscle relaxation. Rocuronium may be a better choice because of absence of any active metabolites and safe excretion even in patients with liver disease.

Essential monitoring during general anesthesia includes continuous ECG monitoring, heart rate, oxygen saturation, non-invasive blood pressure and end-tidal CO_2 concentration.

POSTOPERATIVE PAIN RELIEF

Management of postoperative pain in these patients is very important. A multimodal approach often provides the best pain relief. Various strategies for reducing postoperative pain are present which can be used alone but better approach is to use it in combination with each other for their synergistic effect as it maximises postoperative pain relief with minimal complications):

1. *Epidural top-ups*: If the patient had surgery done under epidural or CSE block, pain relief can be provided with intermittent (6-8 hourly for first 48 hours) epidural top-ups of local anaesthetic solution (6-8 ml of 0.25% bupivacaine) by the anaesthesiologist.
2. *Opioids*: Opioids like Butorphanol and tramadol can be given both intramuscularly or epidurally for control of postoperative pain. Butorphanol 1-2 mg (i/m or epidurally) and tramadol 50-100 mg (i/m or epidurally provide good pain relief.
3. *NSAIDs*: Intramusuclar diclofenac (50-75 mg) or transdermal diclofenac patch (100-200 mg) have been used extensively for postoperative pain relief but intramuscular piroxicam 2 ml i/m OD has been shown to provide excellent pain relief.
4. Patient control analgesia (PCA) through PCA pumps with a set lock out interval and patient controlled epidural analgesia (PCEA) allow patient to have a control over her pain relief, thus reducing the periods of breakthrough pain in postoperative period. Provision for PCA pumps depend on the available infrastructure

CONCLUSION

Anesthetic decisions for the management of vaginal surgeries should be based on the advantages offered by particular anesthetic technique being adopted. There is substantial body of evidence to suggest the definite advantages and benefits of regional anesthetic technique especially combined spinal epidural for anesthetic management of vaginal surgery. In cases, where patient is not willing for regional technique, a standardised balanced general anesthetic technique with or without continous epidural anesthetsia should be adopted. Last but not the least a multimodal approach utilising epidural top-ups, non-steroidal anti-inflammatory drugs, opioids and patient controlled analgesia maximises post-operative pain relief with minimal complications.

Key Points

1. Regional anesthesia especially the combined spinal epidural (CSE) anesthesia is technique of choice for vaginal surgeries.
2. In vaginal approach for hysterectomy, a dense block to at least T_{10} level provides optimal anesthesia, while abdominal approach usually requires block upto T_4.
3. Advantages of regional anesthesia include decreased blood loss, improved intra-operative and postoperative pain control, and decreased incidence of deep vein thrombosis.
4. Other regional anesthetic techniques for vaginal surgeries include caudal epidural anesthesia, pudendal nerve block and perineal infiltration. However, their indications are very limited.
5. In case of any contraindication for regional anesthesia especially with patients refusal, a standardised balanced general anesthetic technique consisting of proporol induction, muscle relaxation and low-dose inhalational agents with basic minimum mandatory monitoring should be planned after a detailed pre-anesthetic check-up.
6. A multimodal approach utilising epidural topups, non-steroidal anti-inflammatory drugs, patient controlled analgesia (PCA) and opioids maximises postoperative pain relief with minimal complications.

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14 Blood Transfusion: Guidelines, Recommendations and Complications

Nitin Jain, Ashok Kumar Saxena

INTRODUCTION

Blood transfusion is occasionally required in cases of vaginal surgery especially vaginal hysterectomy with or without colporrhaphy for colpoperineorrhaphy and non-descent vaginal hysterectomy. Blood transfusion can be a life saving intervention. However, like all other interventions, it may result in acute or delayed complications and carries the risk of transfusion transmissible infections, including acquired immunodeficiency syndrome, hepatitis, syphilis, malaria and other viral infections. Moreover, the need for transfusion can be minimised by the following means:

1. Prevention or early diagnosis and treatment of anaemia. Iron and vitamin supplements are usually given to augment haemoglobin.
2. Use of intravenous fluid replacement with crystalloids or colloids especially hydroxyethyl starch solutions in cases of acute blood loss.
3. Well-balanced optimum anaesthetic and surgical management.

Although intended for orienting our readers for need for blood transfusion in a case of vaginal surgery the chapter covers broader perspectives and mentions the guidelines for blood transfusion in any post-operative surgical patient.

Indications for Transfusion

- Blood transfusion is mainly give for increasing oxygen carrying capacity.

Contrary to general belief increasing intravascular volume is not an indication for blood transfusion. Crystalloids or colloids are good agents for intravascular volume expansion without increasing the risk of infection.

Hematocrit or hemoglobin (Hb) value at which blood transfusion should be given should be based on clinical judgement such as cardiovascular status, age, anticipated additional blood loss, arterial oxygenation, mixed venous oxygen tension, cardiac output and blood volume.

In 1996, American Society of Anaesthesiologists Practice Guidelines offered following recommendations:

1. Transfusion is rarely indicated when Hb > 10 g/dl.
2. Transfusion is always indicated when Hb < 6 g/dl especially in acute anaemia.
3. For Hb of 6-10 g/dl blood transfusions should be based on patients risk for complications of inadequate oxygenation.
4. Use of single hemoglobin "trigger" is not recommended.
5. Measures for conserving blood loss like preoperative autologous blood donation, intraoperative and postoperative blood recovery, and acute normovolemic hemodilution, deliberate hypotension and pharmacological agents are beneficial and should be used when appropriate.

Habibi and coworkers recommended the following guidelines based on "transfusion trigger" with the rule of thumb that administration of one unit of packed red blood cells (RBCs) would increase hematocrit by 3-5%.

Transfusion is indicated if:

1. Blood loss is more than 20% of blood volume, i.e. more than 1000 ml.
2. Hb < 8 g/dl
3. Hb < 10 g/dl with major disease (emphysema, ischemic heart disease).
4. Hb < 10 g/dl with autologous blood.
5. Hb < 12 g/dl and ventilator dependent.

Autologous Blood Transfusion

In this method patients own blood is pre-operatively withdrawn and is used later either during surgery or post-operatively (acute normovolemic hemodilution).

Advantages include lesser risk for transfusion reactions due to incompatibility of blood.

Complications of autologous blood transfusion include the following:

1. Anaemia
2. Preoperative myocardial ischemia from anaemia.
3. Administration of wrong unit (1:100,000).
4. Need for more frequent blood transfusions.
5. Febrile and allergic reactions.

The ABO-Rh type, crossmatch and antibody screen frequently referred to as compatibility testing should be done for both donor and recipient.

Following steps are recommended for patients who are hypovolemic and require urgent blood transfusion:

1. Infuse crystalloids and colloids.
2. Draw blood sample for typing and crossmatching.
3. If crossmatched blood is not ready or available, following protocol should be followed:

Use type specific, cross-matched blood.

↓

If not available, use type specific, partially crossmatched blood.

↓

If still not available, use type specific or type O Rh –ve cells or type O Rh +ve cells for males or postmenopausal females without a history of previous transfusions.

Storage of Blood

Following anticoagulant preservatives are used for storage of blood:

1. CPDA-1 (21-35 days)—It is stored at 1-6° C. Citrate acts as anticoagulant, phosphate as buffer, dextrose is the red cell energy source and adenine allows RBC to resynthesize ATP(Adenosine triphosphate).
2. AS-1 (Adsol) (42 days)—It contains adenine, glucose, mannitol and sodium chloride.
3. AS-3 (Nutricel) (42 days)—It contains glucose, adenine, citrate, phosphate and sodium chloride.
4. AS-5 (Optisol) (42 days)—It contains dextrose, adenine, sodium chloride and mannitol.

Packed RBC has a slightly lower survival than stored blood.

Quality of blood decreases with length of storage and there is an association with increased morbidity and complications with transfusion of old blood.

Complications

1. Changes in Oxygen Transport

RBC increases transport of oxygen to tissues. As the red cell mass increases, oxygen uptake in lungs also increases. This proportionately increases oxygen delivery to tissues. This respiratory function of red cells may be impaired during preservation, making it difficult for them to release oxygen to the tissues immediately after transfusion.

The magnitude of decrease in oxygen delivery to tissues is related to volume and storage time of infused ACD blood.

2. Coagulopathy

Coagulopathy occurs in massively transfused patients. This depends on a number of factors, most important being volume of blood given and duration of hypotension or hypoperfusion. When such bleeding occurs, the differential diagnosis includes dilutional thrombocytopenia, low factor V and VIII, disseminated intravascular coagulation and hemolytic transfusion reaction. Clinical manifestations include oozing into surgical field, hematuria, gingival bleeding, petechial bleeding from venipuncture sites and ecchymoses.

3. Dilution Thrombocytopenia

This is also a complication of massive blood transfusion. Platelets are readily damaged in stored blood at 4°C. It has been reported that total platelet activity decreases by around 50-70% after six hours of storage.

4. Low Factors V and VIII

These factors are unstable in stored blood and gradually decrease to 15% and 50% of normal respectively, after 21 days of storage.

Criteria for Fresh Frozen Plasma (FFP) administration in case of bleeding diathesis due to depletion of coagulation factors include:

a. Generalized bleeding that cannot be controlled with surgical sutures or cautery.
b. Partial thromboplastin time at least 1.5 times normal.
c. Platelet count greater than 70,000/mm^3 (to ensure that thrombocytopenia is not the cause of bleeding).

5. Disseminated Intravascular Coagulation

In this the clotting system is deranged and this leads to disseminated fibrin deposition, which renders the fluid blood unclottable. The deposited fibrin leads to ischemic necrosis in various organs particularly kidney.

6. Hemolytic Transfusion Reaction

The most confirmatory test is Euglobin lysis time, however, it is not readily available and takes too long to perform.

Other helpful tests include:

1. Platelet count
2. Partial thromboplastin time
3. Plasma fibrinogen level
4. Clot size, stability and lysis
5. Evidence of hemolysis in plasma.

7. Citrate Intoxication and Hyperkalemia

Citrate intoxication occurs because citrate binds calcium and therefore signs and symptoms of citrate intoxication are those of hypocalcaemia, that is, hypotension, narrow pulse pressure, and elevated intraventricular end diastolic pressure and central venous pressure. However, if circulatory volume is well maintained these changes commonly do not occur unless ACD blood is given at a rate greater than 150 ml/70 kg/min, or about 1 unit of blood per 5 min in an average sized adult.

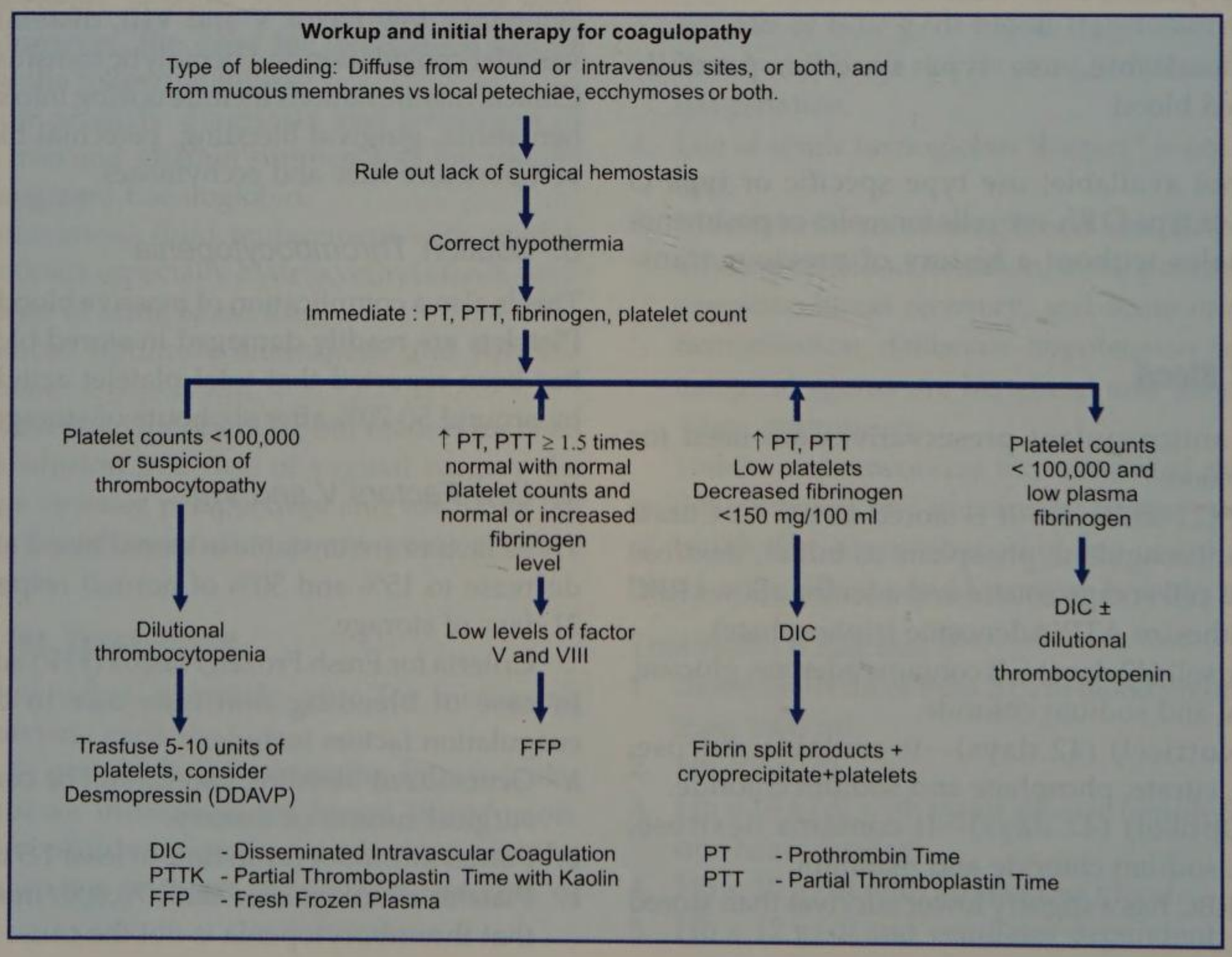
Hypothermia, liver disease, liver transplantation and hyperventilation increase the possibility of citrate intoxication.

Hyperkalemia is also a rare complication of blood transfusion. This usually occurs when stored blood more than 21 days old is transfused in large amounts at a rate of 120 ml/min or more.

Treatment of the above conditions is administration of calcium. However, a cautious approach is recommended as calcium may cause cardiac arrythmias, particularly in patients anaesthetized with halothane. Therefore, routine administration of calcium is not recommended.

8. Temperature

Administration of unwarmed blood at 4°C can decrease the recipient temperature. This along with cool temperature of operating room causes postoperative shivering


Workup and initial therapy for coagulopathy
Type of bleeding: Diffuse from wound or intravenous sites, or both, and from mucous membranes vs local petechiae, ecchymoses or both.
Rule out lack of surgical hemostasis
Correct hypothermia
Immediate : PT, PTT, fibrinogen, platelet count
Platelet counts <100,000 or suspicion of thrombocytopathy
↑ PT, PTT ≥ 1.5 times normal with normal platelet counts and normal or increased fibrinogen level
↑ PT, PTT Low platelets Decreased fibrinogen <150 mg/100 ml
Platelet counts < 100,000 and low plasma fibrinogen
Dilutional thrombocytopenia
Low levels of factor V and VIII
DIC
DIC ± dilutional thrombocytopenin
Trasfuse 5-10 units of platelets, consider Desmopressin (DDAVP)
FFP
Fibrin split products + cryoprecipitate+platelets
DIC - Disseminated Intravascular Coagulation
PTTK - Partial Thromboplastin Time with Kaolin
FFP - Fresh Frozen Plasma
PT - Prothrombin Time
PTT - Partial Thromboplastin Time

which increases the oxygen consumption. Increased oxygen consumption causes an increase in cardiac output. If temperature decreases to less than 30°C, ventricular irritability and even cardiac arrest may occur.

Safest and most common method of warming blood is to pass it through plastic coils immersed in warm water (37°C to 38°C) bath.

9. Acid Base Abnormalities

The pH of most storage media is acidic (CPD 5.5). When this solution is added to a unit of freshly drawn blood, pH of blood immediately decreases to 7.0-7.1.

Treatment of this acidosis is administration of intravenous sodium bicarbonate but this is given only in cases of metabolic acidosis as seen on arterial blood gas analysis.

10. Shock Lung and ARDS

Respiratory insufficiency in patients with severe trauma and hemorrhage (shock lung) or ARDS is a result of accumulation of particulate matter not filtered by standard 170 micron filter.

11. Transfusion Reactions

Hemolytic transfusion reactions: These are of two types Intravascular and extravascular.

Intravascular hemolysis occurs when there is a direct attack on transfused donor cells by recipient antibody and complement. These are due to ABO incompatibility and are frequently fatal.

Extravascular hemolytic reactions are generally less serious. In this recipient antibody coats but does not hemolyse the transfused RBCs. Destruction occurs primarily in the reticuloendothelial system.

Signs and symptoms: The classical signs and symptoms of hemolytic transfusion reaction include:

Signs masked by anaesthesia	*Signs detectable under general anaesthesia*
1. Fever	1. Flushing
2. Fever with chills	2. Hemoglobinuria
3. Chest pain	3. Hypotension
4. Nausea	4. Bleeding diathesis

Most common manifestation of intravascular hemolysis is hemoglobinuria. Common laboratory tests to detect hemolytic transfusion reaction include:

1. Serum haptoglobin
2. Plasma and urine hemoglobin
3. Bilirubin
4. Direct antiglobulin—Most confirmatory test.

Delayed hemolytic transfusion reaction (immune extravascular reaction): This type of reaction occurs mainly in recipients sensitized to RBC antigens by previous blood transfusions or pregnancy. These are mostly due to Rh incompatibility.

Any patient who has an unexplained decrease in haematocrit 2 to 21 days after a transfusion, even without obvious hemolysis, a differential diagnosis of delayed hemolytic transfusion reaction should always be kept in mind.

Non-hemolytic transfusion reactions: These are not serious and are either febrile or allergic in nature. Common febrile reactions include chills, fever, headache, myalgia, nausea and non-productive cough. Other less frequent symptoms are hypotension, chest pain, vomiting and dyspnea. Direct antiglobulin test readily differentiates a hemolytic febrile reaction from fever due to other causes.

Common allergic reactions include urticaria associated with itching and occasionally facial swelling. Incidence of allergic reactions is 3%. There is no need to stop the transfusion in cases of mild allergic reactions. A single dose of antihistaminic usually suffices.

12. Transmission of Infections

Common infections transmitted by blood transfusion include:

1. Human immunodeficiency virus
2. Human T cell leukemia virus.
3. Cytomegalovirus (CMV).
4. Hepatitis B and Hepatitis C virus.
5. Yersinia enterocolitica, syphilis and malaria.

13. Transfusion Associated Graft vs Host Disease

This disease occurs when donor lymphocytes from transfused blood products engraft in the recipient, initiating an immune reaction against host tissue. Manifestations include generalized rash, leukopenia and thrombocytopenia. Prevention is by irradiation of blood.

14. Transfusion Related Acute Lung Injury

It manifests as non-cardiogenic pulmonary oedema resulting from immune reactivity of certain leucocyte antibodies a few hours after transfusion.

Blood and Blood Component Therapy

1. Whole Blood (CPD Adenine 1)

Description: The 450 ml whole blood donation contains upto 510 ml total volume.

1. The 450 ml donor blood.
2. The 63 ml anticoagulant preservative solution.
3. No functional platelets.
4. No labile coagulation factors (V and VIII).

Storage: Between 2°C and 6°C in approved blood bank refrigerator. Transfusion should be started within 30 minutes of removal from refrigerator.

Indications: Red cell replacement in acute blood loss with hypovolemia.

1. Exchange transfusion.
2. Patients needing red cell transfusions where red cell concentrates or suspensions are not available.

Contraindications: Risk of volume overload in patients with chronic anaemia and incipient cardiac failure.

Administration: Must be ABO and Rh compatible.

1. Do not add any medication to a unit of blood.
2. Complete transfusion within 4 hours of commencement.

2. Red Cell Concentrate (Packed Red Cells)

One unit contains 150-200 ml of red cells from which most of the plasma has been removed. It consists of hemoglobin of approximately 20 gm/100 ml.

Storage: Same as whole blood.

Indications: Replacement of red cells in anemic patients.

3. Red Cell Suspension

The hematocrit value is 40% in whole blood and 70% in packed erythrocytes.

One unit contains 150-200ml red cells with minimal residual plasma to which 100ml of normal saline, adenine, glucose, mannitol solution (SAG-M) or an equivalent red cell nutrient solution has been added.

4. Leucocyte Depleted Red Cells

A red cell suspension or concentrate containing less than 5000,000 white cells per pack, prepared by filtration through a leucocyte depleting filter.

Indications: Minimizes white cell immunization in patients receiving repeated transfusions.

1. Reduces risk of CMV transmission in special situations.
2. Patients who have experienced two or more previous febrile reactions to red cell transfusion.

5. Platelet Concentrates

Single donor unit in a volume of 50-60 ml of plasma should contain:

1. Less than 55×10^9 red cells.
2. Less than 0.12×10^9 leucocytes.

Unit of issue: Single donor unit includes platelets prepared from one donation. Pooled unit contains platelets prepared from 4-6 donor units 'pooled' into one pack to contain an adult dose of at least 240×10^9 platelets.

Storage: Upto 72 hours at 20°C to 24°C (with agitation). Longer storage increases the risk of bacterial proliferation and septicemia in the recipient.

Indications

A. *Nonbleeding patient*
   1. Platelet count (PC) < 20,000/mm^3
   2. PC < 50,000 mm^3 in impending surgery/invasive procedure.

B. *Bleeding patient*
   1. Platelet count (PC) < 50,000/mm^3
   2. Proven DIC with PC < 50,000/mm^3
   3. Blood loss > 1 blood volume with PC < 50,000/mm^3
   4. PC < 1,00,000/mm^3 with
      — Major surgery of critical organ
      — Post-cardiopulmonary bypass procedure
      — Retinal or cerebral hemorrhage
   5. Platelet function defect, regardless of PC.

Contraindications: It is not generally indicated for prophylaxis of bleeding in surgical patients, unless known to have significant preoperative platelet deficiency. It is also not indicated in:

1. Idiopathic autoimmune thrombocytopenic purpura (ITP).
2. Thrombotic thrombocytopenic purpura(TTP).
3. Untreated disseminated intravascular coagulation (DIC).
4. Thrombocytopenia associated with septicemia; until treatment has commenced or in cases of hypersplenism.

Dose: The 1 unit of platelet concentrate/10 kg body weight in a 60-70 kg adult, 4-6 single donor units containing at least 240×10^9 platelets should raise the platelet count by $20\text{-}40 \times 10^9$/L.

Administration: After pooling, platelet concentrates should be infused as soon as possible, generally within 4 hours.

Complications: Febrile non-hemolytic and allergic urticarial reactions.

6. Fresh Frozen Plasma (FFP)

Description: One FFP pack contains plasma separated from one whole blood donation within 6 hours of collection and then rapidly frozen to – 25°C or colder. It contains normal plasma levels of stable clotting factors, albumin and immunoglobulin.

Unit of issue: Usual volume of FFP pack is 200-300 ml.

Storage: It can be stored at –25°C or colder for upto one year. Before use it should be thawed in blood bank in water at temperature between 30°C to 37°C. Once thawed it is stored in a refrigerator at + 2°C to + 6°C.

Indications: Replacement of multiple coagulation factor deficiencies:

1. Liver disease.
2. Warfarin overdose.
3. Depletion of coagulation factors in patients receiving large volume transfusions.
4. Disseminated intravascular coagulation (DIC).
5. Thrombotic thrombocytopenic purpura(TTP).
6. Blood loss > 1 blood volume.
7. PT/PTTK > 1.5 × normal.

Dose: Required dose of 12-15 ml/kg.

Administration: ABO compatible.

Cryoprecipitate

Description: It is prepared from fresh frozen plasma by collecting the precipitate formed during controlled thawing at + 4°C and resuspending it in 10-20 ml plasma. It contains about half of factor VIII and fibrinogen as compared to that in the donated whole blood.

Storage: It can be stored at – 25°C or colder for up to one year.

Indications: As an alternative to factor VIII concentrate in the treatment of inherited deficiencies of:

1. Von Willebrand's factor (Von Willebrand's disease).
2. Factor VIII (hemophilia A).
3. Factor XIII.
4. It can also be used as a source of fibrinogen in acquired coagulopathies like DIC.
5. Fibrinogen < 120 mg/dl and bleeding.

Dose: Required dose of 1.5 unit/10 Kg.

Administration: It should be used within 6 hours of thawing.

CONCLUSIONS

In conclusion, the decision to transfuse blood or blood components in patients undergoing vaginal surgeries should always be based on a careful and detailed evaluation of clinical and laboratory indications. Well timed decision making for blood transfusion should be based on a fixed protocol based on guidelines and recommentations regarding the clinical use of blood and blood components, taking the individual patient needs into account. However, the responsibility for ultimate decision to transfuse blood intraoperatively rests with the individual anesthesiologist managing vaginal surgeries. Blood transfusion used correctly rationally and logically can always be life-saving.

Key Points

1. Safe blood products, used correctly can be life saving. However, even with high quality standards, transfusion carries some risks.
2. Blood products should be kept within the correct storage conditions in order to prevent loss of function or bacterial contamination.
3. The transfusion of incompatible blood component is the most common cause of acute transfusion reactions, which may at times be fatal.
4. Safe transfusion depends on avoiding incompatibility between the donor's red cells and antibodies in patient's plasma.
5. Whole blood and red cells should be infused within 30 minutes of removal from the refrigeration.
6. Blood should never be warmed in a bowl of hot water as this could lead to hemolysis of red cells which could be life threatening.
7. Severe reactions most commonly present during first 15 minutes of a transfusion. All patients and, in particular, unconscious patients should be intensively monitered during this period.
8. Acute reactions may occur in 1 to 2% of transfused patients. Rapid recognition and management of reaction can save patients' life.

9. Bacterial contamination in red cells or platelet concentrates is an under-recognised and under-estimated cause of acute transfusion reactions.
10. Transfusion-transmitted infections are the most serious delayed complications of transfusion.
11. The infusion of large volumes of blood and intravenous fluids may cause haemostatic defect or metabolic disturbances (e.g. hyperkalemia etc.).

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15 Sterilization and Disinfection of Surgical Instruments and Endoscopes

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INTRODUCTION

Contact of any medical or surgical equipment with patient's tissues or mucous membranes during any invasive procedure imposes a risk of introduction of infection in the patient's body. Improper sterilization or disinfection of equipment increases this risk. To prevent transmission of infectious material to the patients, it is absolutely necessary to disinfect and sterilize the equipments by using appropriate disinfectants and sterilization methods. It is not very essential to sterilize all the items which need to be used on patients. However, it is imperative to know the methods to get rid of pathogens according to the intended use of the equipment.

Many scientifically-based guidelines for disinfection and sterilization of various kinds of equipment have been established and internationally accepted. It is very necessary to comply with these guidelines and judiciously select the disinfection and sterilization procedures depending upon the item to be disinfected.

Terminology

Sterilization

Sterilization means absolute sterility and involves complete elimination or destruction of all forms of microbial life including spores. The activity involves exposure to some kind of physical or chemical process, e.g., dry heat, moist heat or steam under pressure, ethylene oxide (ETO) gas, hydrogen peroxide gas plasma, and liquid chemicals. Micro-organisms are killed according to a logarithmic order of death when subjected to a sterilization process, i.e. a percentage of initial concentration of micro-organisms will die with each unit time of exposure. Thus, absolute sterilization cannot be obtained since it is not possible to reach zero. Statistically, sterility refers to the probability that an item is not contaminated. This probability is referred to as the 'Sterility Assurance Level (SAL) of the product and is scientifically expressed as 1×10^{-n}. For example, a generally accepted standard of SAL is 1×10^{-6} which implies that 99.9999% of items are sterile and no more than 1 in 1 million products are unsterile after sterilization.

When chemicals are used in appropriate concentration for purposes of sterilization, they are called *Chemical Sterilants* e.g., ≥ 2.4% glutaraldehyde, 0.95% glutaraldehyde with 1.64% phenol/phenate, 7.5% stabilized hydrogen peroxide, 7.35% hydrogen peroxide with 0.23% peracetic acid, 0.2% peracetic acid, and 0.08% peracetic acid with 1.0% hydrogen peroxide.[1] The term sterilization should not be confused with disinfection and there is no term as "partially sterile." Moreover, the chemical sterilants behave as disinfectants if used in lower recommended concentrations and for less exposure time.

Disinfection

Disinfection is the process of destroying or inhibiting growth of many or all pathogenic micro-organisms on inanimate objects. It is usually accomplished by the use of liquid chemicals or wet pasteurization. A traditional definition differentiates disinfection from sterilization by its lack of sporicidal property. But this is not completely true. A few disinfectants will kill spores with prolonged exposure times (3-12 hours) and are even called as *chemical sterilants*. Eventually, three levels of disinfection have been described. ***High-level disinfection*** is intended for killing all bacteria, viruses and fungi and even spores if concentration and contact time is sufficient. Food and

drug administration's (FDA) definition of high-level disinfection is a chemical sterilant used for a shorter contact time to achieve a 6-$\log_{10}$ kill of an appropriate mycobacterium species. Cleaning followed by high-level disinfection should eliminate sufficient pathogens to prevent transmission of infection.[2, 3] ***Intermediate level disinfection*** shall kill most bacteria, viruses and fungi but not necessarily spores. Mycobacterium tuberculosis may be inactivated. ***Low level disinfection*** kills most vegetative bacteria, fungi and least resistant viruses including HIV virus in a short period of time (≤ 10 minutes).

Cleaning

Cleaning is the process of removal of visible foreign matter and dirt whether organic or inorganic, or destruction of invisible soil, which may be pathogens or objectionable micro-organisms, from equipment and surfaces.

Decontamination

Decontamination implies reduction of microorganisms on the item so that it is safe to handle, use or discard. A good cleaning technique generally achieves decontamination.

Germicide

Germicide is an agent that can kill germs (pathogenic organisms) or micro-organisms. The term germicide includes both antiseptics and disinfectants. Antiseptics are germicides applied to living tissue and skin while disinfectants are antimicrobials applied only to inanimate objects. Antiseptics are generally meant to be used on the skin and not for surface disinfection, and disinfectants, similarly are not used for skin antisepsis because they may cause injury to skin and other tissues. Other terms with the suffix *-cide* or *-cidal* are also used e.g., bactericide, tuberculocide, virucide, sporicide and fungicide.

Bacteriostatic

Bacteriostatic refers to an agent that can reversibly inhibit bacterial growth without necessarily killing the bacteria.

Biological Indicators

Biological indicators involve a sterilization-process monitoring device that has a standardized, viable population of microorganisms usually in the form of bacterial spores of high resistance to the mode of sterilization being monitored. Subsequent growth or failure of the micro-organisms to grow under suitable conditions are studied which indicates the adequacy of the conditions to achieve sterilization.

Chemical Indicators

Chemical indicators incorporate a sterilization-process monitoring device designed to respond to one or more process parameters of a sterilization cycle by showing a characteristic chemical change.

RATIONALISED APPROACH TO STERILIZATION AND DISINFECTION

In 1968, Earle H. Spaulding[4] described a rationalised classification system that divided medical devices into three categories based on the risk of infection involved with their use. This system of classification is very clear, logical and refined in such a way that most of the agencies and health professionals involved in infection control e.g., FDA, the Centre for Disease Control and Prevention (CDC), epidemiologists, microbiologists and professional medical organizations use it to determine the degree of disinfection or sterilization required for various medical devices.[5-9] According to this concept, the items can be classified as critical items, semi-critical items and non-critical items.

Critical Items

The items that enter vascular system or sterile tissues, or have blood flowing through them are designated as critical items e.g., surgical instruments, implants, needles, cardiac and urinary catheters, endoscopes and accessories, laparoscopes and arthroscopes, ultrasound probes used in sterile body cavities and some dental instruments. These items must be sterilized properly, preferably by steam sterilization. Other sterilants like ETO, hydrogen peroxide gas plasma or liquid chemicals may be used if the item is heat-sensitive (Table 15.1).

Semi-critical Items

The items that come into contact with intact mucous membranes or non-intact skin and do not ordinarily penetrate sterile tissue are called semi-critical items, e.g., respiratory therapy and anesthesia equipment,

Table 15.1: Methods of sterilization and disinfection*

Objects	Sterilization		Disinfection		
	Critical Items				
	Procedure	*Exposure time*	*High-level (Semi-critical items) Procedure (Exposure time 12-30 min at ≥ 20° C*	*Intermediate-level (Some semi-critical items and non-critical items) Procedure (Exposure time ≥ 1 min)*	*Low-level (non-critical items) Procedure (Exposure time ≥ 1 min)*
Smooth, hard surface	A	MR	D	K	K
	B	MR	E	L	L
	C	MR	F	M	M
	D	10 h at 20-25^{0}C	H	N	N
	E	NA	I		O
	F	6 h	J		
	G	12 m at 50-56^{0}C			
	H	3-8 h			
Rubber tubing and catheters	A	MR	D		
	B	MR	E		
	C	MR	F		
	D	10 h at 20-25^{0}C	H		
	E	NA	I		
	F	6 h	J		
	G	12 m at 50-56^{0}C			
	H	3-8 h			
Polyethylene tubing and catheters	A	MR	D		
	B	MR	E		
	C	MR	F		
	D	10h at 20-25°C	H		
	E	NA	I		
	F	6 h	J		
	G	12 m at 50-56°C			
	H	3-8 h			
Lensed instruments	A	MR	D		
	B	MR	E		
	C	MR	F		
	D	10 h at 20-25°C	H		
	E	NA			
	F	6 h			
	G	12 m at 50-56°C			
	H	3-8 h			
Oral and rectal thermometers				K	
Hinged instruments	A	MR	D		
	B	MR	E		
	C	MR	F		
	D	10 h at 20-25°C	H		
	E	NA	I		
	F	6 h	J		
	G	12 m at 50-56°C			
	H	3-8 h			

***Modified From 1**

ABBREVIATIONS

A—Heat sterilization, including steam or hot air (see manufacturer's recommendations, steam sterilization processing time from 3-30 minutes)

B—Ethylene oxide gas (see manufacturer's recommendations, generally 1-6 hours processing time plus aeration time of 8-12 hours at 50-60°C)

C—Hydrogen peroxide gas plasma (see manufacturer's recommendations for endoscope or medical device restrictions on internal diameter and length; processing time between 45-72 minutes)

D—Glutaraldehyde-based formulations (≥ 2% glutaraldehyde, caution should be exercised with all glutaraldehyde formulations when further in-use dilution is anticipated); glutaraldehyde (0.95%) and 1.64% phenol/phenate. One glutaraldehyde-based product has a high-level disinfection claim of 5 minute at 35°C.

Contd...

Contd...

E—Ortho-phthalaldehyde 0.55% (FDA cleared as high-level disinfectant; passes the Sporicidal Activity Test in 32 hr at 20°C but not cleared as a chemical sterilant)
F—Hydrogen peroxide 7.5% (will corrode copper, zinc, and brass)
G—Peracetic acid, concentration variable but 0.2% or greater is sporicidal. Peracetic acid immersion system operates at 50-56°C.
H—Hydrogen peroxide (7.35%) and 0.23% peracetic acid; hydrogen peroxide 1% and peracetic acid 0.08% (will corrode metal instruments)
I—Wet pasteurization at 70°C for 30 minutes with detergent cleaning
J—Hypochlorite >650-675 ppm active free chlorine, single use chlorine generated on site by electrolyzing saline (may corrode metal instruments)
K—Ethyl or isopropyl alcohol (70-90%)
L—Sodium hypochlorite (5.25-6.15% household bleach diluted 1:500 provides >100 ppm available chlorine)
M—Phenolic germicidal detergent solution (follow product label for use-dilution)
N—Iodophor germicidal detergent solution (follow product label for use-dilution)
O—Quaternary ammonium germicidal detergent solution (follow product label for use-dilution)
MR—Manufacturer's recommendations
NA—Not applicable.

laryngoscope blades, endotracheal tubes, broncoscopes, gastro-intestinal endoscopes, cryosurgical probes, esophageal manometry probes, anorectal manometry catheters, and diaphragm fitting rings. These devices should preferably receive high-level disinfection and should be free of all micro-organisms, although small numbers of bacterial spores may be present. Chemical disinfectants are most commonly used for disinfecting these kinds of equipment (see Table 15.1).

Non-critical Items

Devices that come in contact with intact skin but not mucous membranes, are included in this category. Intact skin acts as an effective barrier to most of the micro-organisms. Therefore, high level sterility of non-critical items is not necessary. Intermediate level disinfection is required if these items are contaminated with blood, otherwise a low level disinfection is adequate. The examples of these items are blood pressure cuffs, bedpans, bed rails, linens, bedside tables, patient furniture, food utensils, crutches, floors, telephone sets, key board of computer and other items in patient care areas. Though there is virtually no risk of transmitting infections to patients through non-critical items when these are used on them, these items e.g., bedside tables, bed rails could potentially contribute to secondary transmission by contaminating hands of the healthcare personnel or by contact with medical equipment that will subsequently come in contact with other patients.[5, 10-13]

Almost all non-critical reusable items may be decontaminated at the place of their use and need not be transported to a central sterilization unit. The exposure time and other instructions for use may be followed according to label-claim of the low-level disinfectant (see Table 15.1).

The regularly used mops and reusable cleaning cloths for achieving low-level disinfection, unfortunately, are commonly not kept adequately cleaned and disinfected. If the water-disinfectant mixture is not changed regularly e.g., after every three to four rooms and no longer than 60 minute intervals, the mopping procedure may actually spread heavy microbial contamination throughout the hospital. Even use of phenolic compounds have been found to be less effective and standard laundering has been said to provide acceptable decontamination of heavily contaminated mop-heads. It is recommended that the mops be subjected to daily laundering.[14]

Cleaning of Equipment

A meticulous cleaning process should always precede sterilization or decontamination of instruments. Failure to achieve adequate cleaning increases the organic and microbial challenge to the disinfectant or sterilants and may result in ineffective disinfection or sterilization of instruments or equipment. Cleaning must be aimed at removal of all adherent visible soil from the surfaces, crevices, joints and lumens of instruments. It is pertinent to mention here that all personnel involved in the cleaning process must wear face mask, eye protection shield, gloves and liquid proof gown for self-protection.

Pre-cleaning

Pre-cleaning is done to prevent drying of blood and debris on and inside instruments or to soften previously dried debris. This process starts in the operating room itself and instruments should be kept rinsed even while transporting the instruments to a decontamination area. After conclusion of surgery, instruments are sorted and are kept in a soak basin or a washer-sterilizer tray. Proteolytic enzymatic detergent agent; plain, clean, demineralised distilled water or a non-corrosive detergent-disinfectant can be used for soaking the instruments. Instruments should not be soaked in any chlorine compound. Phenolic or quaternary ammonium products with corrosion inhibitors are suitable agents.

Cleaning

Cleaning of smooth surfaces may remove 90% of micro-organisms trapped in dirt. It is often done with a clean soft cloth and a detergent diluted in warm water. Damp wiping or mopping of a surface with or without detergent is also done. Dusters or brooms are not used because they disperse dust.

The specific area earmarked for cleaning of equipment and instruments is called decontamination area which should be a separate area from scrub sinks. Clean warm water with a non-corrosive, free-rinsing, preferably a proteolytic-enzymatic detergent should be used for the cleaning purpose. Temperature of the cleaning water should not exceed 45° C, as it may coagulate the bio-burden. Instruments are cleaned to remove gross debris and residual blood. Complex instruments with detachable parts should be disassembled to expose all areas to the process of cleaning. Sharp and delicate instruments need to be handled separately and micro-instruments should be cleaned only manually. Cleaning can be accomplished either manually, by using a washer sterilizer or by ultrasonic method.

Manual Cleaning of all instruments must precede other cleaning processes. Serrations should be cleaned using a soft brush. Extreme care must be taken to prevent spraying of contaminated material while using a brush for cleaning which must be kept below the level of water. Cleaning of endoscopes prior to chemical exposure includes purging the air/water channel using enzymatic detergent solution, cleaning the exterior of the instrument, and brushing all valves and accessible channels. The endoscope must then be immersed in fresh enzymatic detergent solution. Some automated reprocessors provide mechanism for irrigation of enzymatic solution. If not, this step must be done manually prior to beginning the automated cycle.

Washer sterilizers or washer decontaminators are also used for mechanical cleaning of instruments after removal of gross debris manually. These machines have a spray force action i.e., the detergent solution enters the instrument chamber under pressure through fixed or rotating arms for the wash cycle after cold water pre-rinse. This is followed by a water rinse and heated air-drying.

Ultrasonic cleaning is a very useful method to clean surgical instruments with complicated surfaces, serrations and blind holes which are difficult to clean. Ultrasonic cleaners use high frequency sound waves to thoroughly clean these types of instruments by a process of cavitation. Even micro-instruments, glassware, rubber goods and thermoplastics can be thoroughly cleaned using this method. Instruments are completely immersed in the cleaning solution of the tank of these machines and sound waves are then generated to produce tiny bubbles, these bubbles expand until they are unstable and then collapse. The *implosion* generates minute vacuum areas that dislodge, dissolve, or disperse soil to accomplish the process of cleaning.

Final Rinsing

The instruments should be subjected to final and thorough rinsing in hot distilled or deionised water, after the process of thorough cleaning is over.

Drying

Instruments can corrode and rust if they are stored with moisture trapped in them. Therefore, it is very necessary that these are promptly and completely dried using a lint free towel before reassembling or sorting. It is not advised to air-dry the instruments because of risk of contamination but hot air, close chamber ovens are useful for drying washed instruments.

Lubricating

After cleaning, most instruments with moving parts should be lubricated by immersing them for 30 to 45 seconds in an antimicrobial, rust inhibitor, water-soluble lubricant that is steam penetrable. This is especially important after ultrasonic cleaning because the sonic energy removes the lubricant during cleaning. The antimicrobial properties of the lubricant help in preventing microbial growth in the lubricant bath that can be reused for up to 7 days. A water-soluble lubricant deposits a thin film deep in box locks, hinges, and crevices but will not interfere with sterilization. Mineral oils, silicones and machine oils should never be used for this purpose, the residue left by them interferes with steam or ethylene oxide sterilization. Manufacturer's instructions for lubricating an instrument must be followed to keep the instrument in good working condition.

Storage after Cleaning

Cleaned, dried and unwrapped instruments should be stored on a soft material such as plastic sheeting or foam.

Flexible endoscopes are stored vertically and their accessories may also be hung. Instruments and equipment subsequently can be packed using appropriate packaging material for the sterilization or disinfectant process.

METHODS OF STERILIZATION AND DISINFECTION

Steam

This thermal method uses moist heat in the form of saturated steam under pressure and is most dependable of all methods. The basic principle of steam sterilization is to expose each item to direct steam contact at the required temperature and pressure for a specified time. This causes destruction of microbes by coagulation and denaturation of the proteins within the cells. No living organism can survive a direct exposure to saturated steam at 121°C (250°F) for more than 15 minutes. The unit which is used to create the required pressurised steam at high temperature is called an autoclave. Therefore, autoclave machines typically operate at 121°C (250°F) at 15 pounds per square inch gauge (psig) within the chamber. If the applied temperature is increased, exposure time is decreased. The other temperature used in some sterilizers is 132°C (270°F).

The quality of the steam used for sterilization should be such that it is dry saturated steam with dryness fraction ≥ 97% and the chamber should have no more than 3% liquid water.[15] Steam, for a specified time at a required temperature, must penetrate every fibre and reach every surface of items to be sterilized. When it comes in contact with the items, it condenses, thereby heating and wetting the items to be sterilized. At the end of the cycle, revaporization of water condensate must effectively dry the contents of the load to maintain sterility.

Autoclaves generally have automatic controls that ensure that the correct sequence is followed. The air has to be evacuated before the sterilization process is started. Any air present in the sterilizing chamber will reduce the quantity of steam entering chamber and will not allow achievement of required temperature. As the steam saturates the chamber, the intended temperature is reached and the sterilization cycle starts. At the end, steam is evacuated from the autoclave to avoid condensation of water on the load. Advantages, disadvantages and characteristic of steam sterilization are listed in Table 15.2.

Types of Steam Sterilizers

Gravity displacement sterilizer: These types work on the principle that air is more than twice as heavy as steam. The steam under pressure is admitted from the top, sides or back of the sterilizing chamber and displaces the air downward to force it out through a discharge outlet at the bottom of machine. The sterilization cycle begins when a thermometer located at the outlet records the desired temperature in the chamber after the air is completely replaced by steam. Care should be taken that all the items in the chamber are arranged in such a manner that they present least resistance to the flow of steam from above downward and that no air trapping occurs to decrease the sterilizing power of steam. The gravity displacement autoclaves are primarily used to process laboratory media, water, pharmaceutical products, regulated medical waste, and nonporous articles whose surfaces have direct steam contact.

At constant temperatures, sterilization times vary depending on the type of item (e.g., metal, rubber, plastic or items with lumens), whether the item is wrapped or unwrapped, and the sterilizer type.

Exposure time is at least 15 minutes, generally 30 minutes, at a temperature of 121°C to 123°C and pressure of 15 to 17 psi. However, manufacturer's instructions should be considered for varying times and setting of these sterilizers.

Pre-vacuum sterilizers: These sterilizers are similar to the gravity displacement sterilizers except that they are fitted with a vacuum pump to ensure air removal from the sterilizing chamber and load before the steam is admitted. The vacuum is used for a period of 8-10 minutes and causes nearly instantaneous steam penetration even into porous loads. The sterilizing steam thus almost instantaneously penetrates the packages. A post-vacuum cycle draws moisture from the load to shorten drying time. Temperatures in these sterilizers are controlled at 132°C to 136°C at a pressure of 27 psi and a minimum of 4 minutes exposure time is used.

Flash or high speed pressure sterilizers: Flash sterilization is a modification of conventional gravity or pre-vacuum steam sterilization in which the flashed item is placed in an open tray or is placed in a specially designed, covered, rigid container to allow for rapid penetration of steam. These sterilizers operate at a temperature of 132°C and pressure of 27-28 psig. Minimum of 3 minute exposure time is required to sterilize non-porous items without

Table 15.2: Summary of advantages and disadvantages of commonly used sterilization technologies*

Sterilization method	*Advantages*	*Disadvantages*
Steam	• Rapidly microbicidal • Penetrates medical packing, device lumens • Rapid cycle time • Cycle easy to control and monitor • Least affected by organic/inorganic soils among sterilization processes listed • Non-toxic to patient, staff, environment	• Deleterious for heat-sensitive instruments • Microsurgical instruments damaged by repeated exposure • May leave instruments wet, causing them to rust • Potential for burns
Hydrogen Peroxide Gas Plasma	• Used for heat- and moisture-sensitive items since process temperature < 50°C • Compatible with most medical devices • Simple to operate, install (208 V outlet), and monitor • Cycle time is 45-73 minutes and no aeration necessary • Only requires electrical outlet • Leaves no toxic residuals • Safe for the environment	• Cellulose (paper), linens and liquids cannot be processed • Endoscopes or medical devices with long narrow or dead end lumen cannot be processed with this agent • Sterilization chamber is small, about 3.5 ft^3 to 7.3 ft^3 • Requires synthetic packaging (polypropylene wraps, polyolefin pouches) and special container tray • Hydrogen peroxide may be toxic at levels greater than 1 ppm
100% ethylene oxide (ETO)	• Compatible with most medical materials • Simple to operate and monitor • Penetrates packaging materials, device lumens • Single-dose cartridge and negative-pressure chamber minimizes the potential for gas leak and ETO exposure	• Lengthy cycle time • Requires aeration time to remove ETO residue • Sterilization chamber is small, 4 ft^3 to 8.8 ft^3 • ETO is toxic, a carcinogen, and flammable • ETO cartridges should be stored in flammable liquid storage cabinet
ETO mixtures 8.6% ETO/91.4% HCFC 10% ETO/90% HCFC 8.5% ETO/91.5% CO_2	• Compatible with most medical materials • Cycle easy to control and monitor • Penetrates medical packaging and many plastics	• Potential hazards to staff and patients • Lengthy cycle/aeration time • ETO is toxic, a carcinogen, and flammable
Paracetic acid	• Rapid cycle time (30-45 minutes) • Low temperature (50-55°C) liquid immersion sterilization • Sterilant flows through endoscope which facilitates salt, protein and microbe removal • Fully automated • Single-use system eliminates need for concentration testing • Standardized cycle • Environmental friendly by-products	• Used for immersible instruments only • Point-of-use system, no sterile storage • Biological indicator may not be suitable for routine monitoring • Some material incompatibility (e.g., aluminium anodized coating becomes dull) • One scope or a small number of instruments processed in a cycle • Potential for serious eye and skin damage (concentrated solution) with contact

*Modified from [1]; CFC = Chlorofluorocarbon, HCFC = Hydrochlorofluorocarbon

lumens. For items with lumen, timing should be atleast 4 minutes for pre-vacuum sterilizer and 10 minutes for gravity displacement type flash-sterilizer.

Flash sterilizers should only be used in urgent, emergency situations e.g., for individual equipment inadvertently dropped or forgotten for which no alternative method exists at that time. This is also useful for processing cleaned patient-care items that cannot be packaged, sterilized, and stored before use. Flash sterilization should not be used for reasons of convenience to save time or as an alternative to purchase additional instrument sets.[16] Implantable devices that need to be placed into a surgically or naturally formed cavity of the human body should never be flash-sterilized because of the potential for serious infections due to absence of protective packaging following flash-sterilization, risk of contamination of processed items during transportation to the operating rooms and lack of timely biological indicators to monitor performance of the sterilization cycle. Some of methods suggested to solve these problems are placing the equipment for flash sterilization in close proximity to operating rooms to facilitate aseptic delivery to the sterile field in an ongoing surgical procedure, extending the exposure time to ensure lethality comparable to sterilized wrapped items e.g., 4 minutes at 132°C, using biological indicators that provide results in one hour for flash-sterilized items and using protective packaging that permits steam penetration.[1]

Monitoring Steam Sterilization

Chemical Check

1. Daily a Bowie and Dick test is carried out in an empty cycle. This cycle is the first cycle of the sterilizer. This test is done to ensure that air has been satisfactorily removed and full steam penetration has occurred during autoclaving. A cross is made with autoclave tape on a sheet of steam-permeable paper or drape which is placed in the middle of a stack of cotton towels and all then put through the sterilization cycle. The complete and uniform change of tape colour indicates satisfactory steam penetration. It does not, however, guarantee that sterilization has been achieved.
2. Weekly an air leak test is carried out on each of the sterilizers, to check the efficiency of the sterilizer.
3. An indicator is incorporated in every cycle to check the correct exposure time, quality of steam and accurate temperature.

Biological Check

4. Weekly an ampoule containing *Geobacillus stearothermophilus* is processed in a challenge pack in the sterilizer and thereafter is incubated along with the positive control, to check the sterilization process.

Mechanical or Physical Check

5. Each sterilization cycle gives the print out of temperature and pressure under which the cycle is processed.

Dry Heat

Dry heat, generally in the form of hot air is used for those items which are not penetrated by either steam or ethylene oxide but can be sterilized by the conduction of heat through them. Higher temperatures and long exposure times are required for hot air sterilization since there is no moisture and a slow process of coagulation of cellular proteins destroys the microbes by conduction of heat. Dry heat is used for sterilizing talcum powder, glassware, petroleum jelly like products, anhydrous oils and instruments that cannot be disassembled or instruments with sharp cutting edges. However, this method cannot be used for fabrics and rubber goods, and may inadvertently destroy some items due to long exposure periods. Electrically heated mechanical convection hot air ovens are used for dry heat sterilization. They operate at a temperature of 191°C (375°F) to 204°C (400°F) with a cycle time of 6 minutes for unwrapped and 12 minutes for wrapped items.

ETHYLENE OXIDE "GAS"

ETO, an alkylaling agent is a highly flammable and explosive liquid that forms a colourless gas. In a gaseous form, it is an excellent microbicidal agent and kills micro-organism and their spores by destroying the DNA and protein structure of the cells if appropriate parameters are provided. These essential parameters are 450 to 1200 mg/L of gas concentration, 37° to 63°C (98° to 145°F) of temperature, 40% to 80% of relative humidity and 1 to 6 hours of exposure time.[17-19] The temperature of the gas directly affects its permeability. The uppermost limit of 63°C matches the highest temperature tolerated by heat sensitive plastics. Moisture is added since dried spores are resistant to sterilization and water molecules carry ETO to reactive sites. Concentration of gas used, temperature and type and density of material to be sterilized determines the length of exposure. Ethylene

oxide can be used in a 100% pure form or in combination with carbon-dioxide, chlorofluorocarbons and hydrochlorofluorocarbons. The present guidelines recommend not using chlorofluorocarbons with ETO because of the environmental hazards.

ETO is a preferred agent for the items that cannot be sterilized by heat like plastics and those which are eroded by steam and moisture (Table 15.2). It completely permeates all porous materials, but does not penetrate metal, glass and petroleum based lubricants. The main disadvantages are the lengthy cycle time, the cost of special equipment and its potential hazards to patients and staff. It is a toxic gas and all the items sterilized by ETO require aeration to dissipate any residual gas remaining on the items. Toxic compounds like ethylene glycol and ethylene chlorohydrins can be formed by the reaction of ETO with many substances and with moisture droplets present on the items to be sterilized. ETO is known to be an occupational carcinogen and teratogen. It is a vesicant and can cause burns or mucus membranes irritation. Like all sterilization processes, the effectiveness of ETO sterilization can be altered by lumen length, lumen diameter, inorganic salts, and organic materials.[20-25] For example, although ETO is not used commonly for reprocessing endoscopes,[26] several studies have shown failure of ETO in inactivating contaminating spores in endoscope channels[25] or lumen test units[20, 22, 24] and residual ETO levels averaging 66.2 ppm even after the standard degassing time.[27] In India, unit-dose single cycle cartridges of ETO are available.

Monitoring Of ETO Sterilization Process

Biological Check

1. In each cycle an ampoule containing *Bacillus atrophaeus* is processed in a challenge pack in the sterilizer and thereafter is incubated along with the positive control, to check the sterilization process. This test is based on the fact that bacterial spores of *B. atrophaeus* are more resistant to ETO than other micro-organisms and therefore, spores of these bacteria are recommended for use as biological indicator.

Physical Check

2. Each sterilization cycle gives the print out of the cycle process that consist of pre-conditioning, time of gas exposure, gas removal and thereafter completion of the cycle followed by aeration.

Chemical Check

3. A process indicator affixed on the peel pouches changes the colour once the pouches are subjected to sterilization.
4. An indicator is incorporated in every cycle to check the correct exposure time, gas penetration and the accurate temperature.

HYDROGEN PEROXIDE GAS PLASMA

Gas plasmas have been called as fourth state of matter after liquids, solids and gases. Gas plasmas are generated in an enclosed chamber under deep vacuum using radio frequency, microwave energy or electrical field to excite the gas molecules and produce charged particles, many of which are in the form of free radicals. Hydrogen peroxide activated in the same manner can be used as a sterilizing agent and is sporicidal even at low concentration. This forms reactive gas plasma consisting of ions e.g., hydroxyl and hydroperoxyl, electrons and neutral atomic particles. These free radicals interrupt the microbial life and those which are not utilized, are converted to oxygen and water. Temperature is kept low at 50°C (122°F) and sterilization occurs in a low moisture environment. At the end of the cycle, the energy field is withdrawn, vacuum is released, and all the vapour is removed and decomposed. Aeration of the item is not necessary as there are no toxic by products. Before sterilization, all the items should be thoroughly clean and dry. They should be kept either unwrapped or wrapped in only non-woven polypropylene because hydrogen peroxide in not compatible with cellulose i.e., woven textiles made up of cotton, paper or linen.

The hydrogen peroxide system can be used for heat-sensitive materials especially new camera systems, endoscopes and their accessories, and some plastics, electrical devices and corrosion-susceptible metal alloys. This method has been seen to be compatible with >95% of medical devices and materials tested.[28, 29]

Like other sterilization processes, the effectiveness of hydrogen peroxide system can be influenced by lumen length, lumen diameter, inorganic salts, and organic materials.[20, 23-25] Since it cannot penetrate lumens more than 31 cm in length or less than 6 mm in diameter, it should not be used for devices with long narrow or dead end lumen.

Gas plasma is a promising sterilization agent and can replace ETO. It offers a low temperature sterilization which is effective on most packaging materials, plastics

and stainless steel instruments. It is not associated with environmental problems or occupational hazards to the personnel involved. The biological indicator used with this system is *Geobacillus stearothermophilus* spores.[30]

PARACETIC ACID

Paracetic acid is a colourless liquid belonging to the family of peroxygen compounds. It has a pungent odour and is miscible with water. It is commercially available as a 35% or 40% solution, is generally unstable and decomposes to give oxygen, acetic acid and other degradable products including hydrogen peroxide and water. Extra oxygen atom on these *peroxy* compounds reacts with cellular components to cause cell death. Usable concentration of 0.2% peracetic acid is rapidly active against all microorganisms including bacterial spores, and is effective in the presence of organic matter.

This system is a quick method of sterilizing a wide variety of heat sensitive instruments like flexible and rigid endoscopes, micro-instruments and items made up of plastics and rubber. The main disadvantage is that only a small number of equipment that too only those that can be completely immersed in the sterilant can be processed in one cycle. Equipment should be pre-cleaned but need not be dry. After sterilization the equipment is rinsed with sterile water. Instruments processed in the system should be used immediately as processor cannot be used as extended storage device.

Cartons of the peracetic acid concentrate should be stored upright in a cool, dry area having a temperature of 30°C (<86°F). The chemical has a shelf life stability of six months. The concentrate may cause irritation of the nose, throat and lungs, and is corrosive to the eye and skin, potentially causing irreversible eye damage or severe burns. Once diluted to 0.2%, peracetic acid is not considered a hazardous waste and can be safely discarded down the drain (Table 15.3).

A chemical indicator for each cycle measures the ionic strength of buffering agents. A biological indicator is available, but may not be suitable for routine monitoring.

FORMALDEHYDE

Formaldehyde is mainly used in a water-based solution in the concentration of 37% formaldehyde in water, called *formalin*. Formalin solution is heated in the presence of adequate humidity in the chemiclave sterilizer to produce fumes. These fumes are non-corrosive and are used for sterilization of heat sensitive items. Formaldehyde is very toxic and is a potent allergen and probable carcinogen. It has unpleasant odour and it is irritating to eyes and mucus membrane. Therefore precautions must be taken in handling formalin and also, all the items sterilized by this method should be thoroughly rinsed with sterile water before use. Rubber and porous material may absorb formaldehyde so they should not be disinfected with this agent.

Formalin tablets have also been used for the same purpose. An airtight cabinet containing formalin tablets can be used to sterilize instruments and also to store them. It is important to keep this cabinet in a well ventilated area. A heat source is required for the larger cabinet, and perforated metal shelves, to allow the vapour to circulate. Heat can be provided by an electric 25 watt light bulb above which a shelf holds the formalin tablets. The container needs to be kept at a room temperature of 20°C. The method requires 7 grams of formalin per cubic metre. Sterilizing time is 12 hours. The cabinet must not be opened during this time. Although this method is known to be practised widely in rural areas, its effectiveness is not certain. The use of formalin is not encouraged if alternative more potent and less toxic methods are available. A good practice achieves destruction of all micro-organisms, including the AIDS virus.

IONIZING RADIATIONS

Gamma rays are electromagnetic waves produced during the disintegration of certain radioactive elements. At the speed of light, the radiations can pass through several feet thickness before losing all their energy. These rays achieve sterilization by ionizing the atoms they hit and the atoms in turn emit secondary electrons that disrupt DNA molecules of the micro-organism resulting in cellular death. Gamma rays can be used to sterilize heat and moisture sensitive items and used commercially by large manufacturers especially for syringes, needles and suture material. Since it can penetrate through large thickness, products can be pre-packed in any kind of material and can be sterilized. There is no risk of any retained radioactivity. However, physical properties of some material like polyvinyl chloride (PVC) are altered by ionizing radiations. When PVC is sterilized by gamma radiations, chloride ions are liberated. This does not cause

Table 15.3: Summary of advantages and disadvantages of chemical agents used as chemical sterilants or as high-level disinfectants*

Sterilization method	*Advantages*	*Disadvantages*
Paracetic acid + Hydrogen peroxide Combination	• Odor or irritation not significant • No activation required	• Materials compatibility concerns (lead, brass, copper, zinc) both cosmetic and functional • Limited clinical experience • Potential for eye and skin damage
Glutaraldehyde	• Excellent materials compatibility • Relatively inexpensive	• Pungent and irritating odor • Relatively slow mycobactericidal activity • Coagulates blood and fixes tissue to surfaces • Respiratory irritation from glutaraldehyde vapour • Allergic contact dermatitis
Hydrogen peroxide	• Does not coagulate blood or fix tissues to surfaces • Inactivates *Cryptosporidium* • No activation required • May enhance removal of organic matter and organisms • No disposal issues • No odor or irritation issues	• Material compatibility concerns (brass, zinc, copper, and nickel/silver plating) both cosmetic and functional • Serious eye damage with contact
Ortho-phthalaldehyde	• Fast acting high-level disinfectant • No activation required • Odor not significant • Excellent materials compatibility claimed • Does not coagulate blood or fix tissues to surfaces claimed	• Slow sporicidal activity • Stains skin, mucous membranes, clothing, and environmental surfaces • Limited clinical experience • More expensive than glutaraldehyde • Eye irritation with contact • Anaphylaxis-like reactions in bladder cancer patients
Paracetic acid	• Low temperature (50-55°C) liquid immersion sterilization • Rapidly sporicidal • Rapid sterilization cycle time (30-45 minutes) • Environmental friendly by-products (acetic acid,O_2, H_2O) • Fully automated • Single-use system eliminates need for concentration testing • Standardized cycle • May enhance removal of organic material and endotoxin • No adverse health effects to operators under normal operating conditions • Compatible with many materials and instruments • Does not coagulate blood or fix tissues to surfaces • Sterilant flows through scope facilitating salt, protein, and microbe removal • Provides procedure standardization (constant dilution, perfusion of channel, temperatures, exposure)	• Used for immersible instruments only, one scope or a small number of instruments can be processed in a cycle • Unstable, particularly when diluted • Potential material incompatibility (e.g., aluminium anodized coating becomes dull) • Biological indicator may not be suitable for routine monitoring • More expensive (endoscope repairs, operating costs, purchase costs) than high-level disinfection • Serious eye and skin damage (concentrated solution) with contact • Point-of-use system, no sterile storage

*Modified from [1]

problems when PVC comes in contact with tissues. However, if this is subsequently exposed to ETO for re-sterilization, the gas forms ethylene chlorohydrin, which is extremely toxic to tissues and harmful. Therefore, irradiated PVC items should not be re-sterilized with ETO.

GLUTARALDEHYDE

It is a saturated dialdehyde, which is most commonly commercially available as a 2% aqueous solution of alkaline or acidic glutaraldehyde, though 2.4%-3.4% solutions are also available, with and without surfactants. It is a high-level disinfectant and cold sterilant, which when activated by adding powdered buffer to the liquid, kills micro-organims by denaturation of their proteins. Glutaraldehyde has excellent biocidal activity, is active in the presence of organic matter and is non-corrosive to metals, rubbers and plastics.[7]

Glutaraldehyde may be used in manual or automated reprocessing protocols. Instruments to be sterilized by glutaraldehyde should be pre-cleaned for blood and residual debris before immersing them in this agent. They should also be dried as moisture can dilute the sterilizing solution. After activation, the solution should be used for the time specified by the manufacture, generally 14 to 28 days, as it loses effectiveness on repeated use. The concentration of glutaraldehyde in the solution should also be monitored before and after each use using special test strips or reagents. For example, test strips for 2.4% glutaraldehyde products are constructed to show failure when the concentration drops below 1.5%. If it is diluted to unacceptable concentrations, it should be discarded even before the full period of activation. After meticulous manual cleaning, high-level disinfection is achievable with a 20 minute exposure at 20°C in a 2% glutaraldehyde solution which does not contain surfactant and which tests above its minimum effective concentration. Since a long immersion time is required for its sporicidal action it is mainly used as a high level disinfectant. It is 100% tuberculocidal in 45-90 minute. Alkaline 2.45% glutaraldehyde is also available where biocidal action against mycobacterium tuberculosis can be achieved in 20 minutes. It is non-corrosive on most equipment and hence a safe agent for sterilizing endoscopes, lensed instruments, most plastic and rubber items.

Health care workers exposed to it should ensure self-protection, as glutaraldehyde is noxious and irritating to tissues. Rinsing of all the equipment sterilized by it should be mandatory as it get absorbed onto the items leading to user's sensitization.

Glutaraldehyde is a noxious and irritant solution and some individuals develop acute sensitivities during its use (Table 15.3). These sensitivities may present as itching of the skin, redness, swelling or yellowing of the skin with prolonged exposure, or irritation to eyes and nasal membranes, headache, coughing, sneezing, and asthma-like symptoms. Glutaraldehyde can be absorbed by inhalation, ingestion and through the skin. It has a detectable odor at 0.04 parts per million volume (ppmv) and is irritating to skin and mucous membranes at 0.3 ppmv. Vapors are released whenever solutions are disturbed and the surface tension is broken. Mixing, adding and removing equipment, or disposing of a glutaraldehyde solution can cause a break in the surface tension. Whenever the glutaraldehyde solution is not being accessed, it should be covered with a tight-fitting lid. The areas where glutaraldehyde is in use must be provided with adequate ventilation and scavenging.

Glutaraldehyde spills small enough not to cause tearing of the eyes and/or respiratory discomfort can be cleaned up with a mop, sponge or towel. The saturated item should be discarded in a tightly sealed biohazard bag. Surfaces should be rinsed thoroughly with water. Large spills may require neutralization with sodium bisulfite or 2% dibasic ammonium phosphate.

ORTHO-PHTHALADEHYDE

OPA solution is a clear, pale-blue liquid which typically contains 0.55% OPA. As compared to gluteraldehyde, OPA has superior mycobatericidal activity and it lasts longer before reaching its minimum effective concentration limit. OPA has other several potential advantages over glutaraldehyde as it does not require activation, has excellent stability over a wide range of pH (pH 3-9), does not require exposure monitoring and has a barely perceptible odour. Like glutaraldehyde, OPA has excellent material compatibility. It is a reusable product with a maximum use life of 14 days.

It is a potential irritant of eyes, skin, nose and other tissues resulting in symptoms such as stinging, excessive tearing, coughing and sneezing. It is a potential skin and respiratory sensitizer that may cause dermatitis with prolonged or repeated contact and may aggravate pre-existing bronchitis or asthma (Table 15.3). In addition,

the product stains proteins on surfaces to grey/black. The items immersed in OPA must be thoroughly rinsed with distilled water before use. It is cleared by FDA as a high-level disinfectant at 20°C at an immersion time of 12 minutes. Small spills may be cleaned up with a damp sponge or absorbent pad. Larger spills should be deactivated with 25 grams of glycine powder as free base per gallon over 5 minutes.

ALCOHOL

"Alcohol" refers to two water-soluble chemical compounds whose germicidal characteristics are generally under estimated—ethyl alcohol and isopropyl alcohol. Alcohol is a commonly used intermediate level disinfectant. Both are rapidly bactericidal, tuberculocidal, fungicidal and virucidal at a 60-90% concentration with an exposure time of 10-15 minutes. They do not kill spores. Its action against viruses is variable. A 70% concentration of ethyl alcohol can inactivate hepatitis virus in 15 minutes and HIV virus in 1 minute.

Alcohols have been used effectively for disinfecting semi-critical instruments and are commonly used to disinfect oral and rectal thermometers, hospital pagers, scissors, stethoscopes, and fiberoptic endoscopes.[31] Alcohol towelettes have been used for years to disinfect small surfaces such as rubber stoppers of multiple-dose medication vials or vaccine bottles.[31] Alcohols are not recommended for sterilizing medical and surgical materials principally because of their lack of sporicidal action, their inability to penetrate protein-rich materials and its corrosive action against stainless steel.

Alcohol is volatile and becomes ineffective as soon as it evaporates. It loses its biocidal activity below a concentration of 50%. It is inactive in the presence of organic soil. Thus, items to be disinfected with alcohol should be carefully pre-cleaned and totally submerged for an appropriate exposure time. It should not be used in lensed instruments with cement mountings because it dissolves the cement. It must never be used repeatedly on rubber or plastic tubing as it causes swelling and hardening of these substances. Because it is highly flammable it must never be used in the presence of electro-cautery or lasers and should be stored in cool, well-ventilated areas.

CHLORINE AND CHLORINE COMPOUNDS

Hypochlorites are chlorine disinfectants are available in liquid form as sodium hypochlorite and in solid form as calcium hypochlorite. Chlorine compounds kill microorganisms by the oxidation of enzymes. They have a broad spectrum of antimicrobial activity i.e., bactericidal, virucidal, fungicidal, mycobactericidal, sporicidal, do not leave toxic residues, are unaffected by water hardness, are inexpensive and fast acting,[32] useful for removing dried or fixed organisms and biofilms from surfaces,[33] and have a low incidence of serious toxicity.[34] These are inexpensive, intermediate to low level disinfectants. Sodium hypochlorite at the concentration used in domestic bleach may produce ocular irritation or oropharygeal, esophageal, and gastric burns.[35-37] Other disadvantages of hypochlorites include corrosiveness to metals in high concentrations (> 500 ppm), inactivation by organic matter, discolouring or "bleaching" of fabrics, release of toxic chlorine gas when mixed with ammonia or acid (e.g., household cleaning agents),[38] and relative stability.[39] When hypochloride solution comes in contact with formaldehyde, a carcinogen bis-chloromethylether is produced.

Chlorine compounds are useful for spot disinfection of counter tops and floors. A 1:10 dilution of 5.25% to 6.15% sodium hypochlorite has been recommended for cleaning blood spills. There is no decomposition of sodium hypochlorite solution after 30 days when stored in a closed brown bottle.[39]

SUPEROXIDE WATER

Antimicrobicidal activity of a new disinfectant, *"superoxidized water"* has also been identified. The main products of this water are hypochlorous acid e.g., at a concentration of about 144 mg/L and chlorine. This disinfectant is generated at the point of use by passing a saline solution over coated titanium electrodes at 9 amperes. The product generated has a pH of 5.0 to 6.5 and a redox potential of 950 mV. The resultant solution is non-corrosive and non-damaging to endoscopes, processing equipment and environment. Studies have shown that freshly generated superoxidized water is rapidly effective within less than two minutes in achieving a 5-$\log_{10}$ reduction of pathogenic microorganisms in the absence of organic loading.

PHENOLIC COMPOUNDS

Phenolics are derived from carbonic acid. Two phenol derivatives commonly found as constituents of hospital disinfectants are ortho-phenylphenol and ortho-benzyl-para-chlorophenol. Published reports on the

antimicrobial efficacy of commonly used phenolics showed that they were bactericidal, fungicidal, virucidal, and tuberculocidal.[31, 40, 41-46] These are very stable and remain active even in the presence of organic matter on prolonged drying. Phenols are considered intermediate to low level disinfectants. Many phenolic germicides are EPA-registered as disinfectants for use on environmental surfaces (e.g., bedside tables, bedrails, laboratory surfaces) and noncritical medical devices. Phenolics are not FDA-cleared as high-level disinfectants for use with semicritical items but could be used to preclean or decontaminate critical and semicritical devices prior to terminal sterilization or high-level disinfection. Tissue irritation precludes their use for instruments that come in contact with skin and mucous membrane. Rubber and plastics may absorb phenol. These have a bad odour and generally difficult to rinse.

BOILING

High-level disinfection is achieved by boiling the instruments at 100°C for a minimum of 10 minutes. The instruments must be completely immersed in already boiling water in a container, preferably with a lid. It is better to use distilled water for boiling. Although probably the most readily available method, it has the distinct disadvantage of blunting instruments. Instruments must not be placed on top of each other. A silicone mat on the bottom of the container will help to protect the instruments. Boiling kills bacteria, fungi and viruses, including the AIDS virus, but not spores.

DISINFECTION AND STERILIZATION OF ENDOSCOPES

Endoscopes e.g., gynaecological and gastrointestinal endoscopes, bronchoscopes, nasopharygoscopes represent a valuable diagnostic and therapeutic tool in modern medical and surgical practice. Flexible endoscopes are introduced in various types of body cavities and therefore acquire high levels of microbial contamination during each use.[47] These endoscopes are particularly difficult to disinfect[48] and easy to damage because of their intricate design and delicate materials.[49] Care of the endoscopes starts from the intra-operative period itself. During surgery all the types of endoscopes and their accessories should be kept clean and moist. Suction tips should be flushed with distilled water intermittently to prevent clogging by blood and tissue debris. It is important that all heat-sensitive endoscopes are meticulously cleaned, carefully transported to the decontamination area after use and subjected to high-level disinfection following each use.

Before subjecting an endoscope to a sterilizing process all detachable parts like light cable and cable adapters should be removed from the telescope. The working head of the flexible endoscopes should not be dipped into detergent solution. A small brush or pipe stem cleaner can be used to clean inside lumen of the channels. Though high-level disinfection is expected to destroy all micro-organisms, a few spores may still survive when high numbers of bacterial spores are present.

According to FDA, liquid chemical sterilants and high-level disinfectants that can be used to reprocess heat-sensitive medical devices, such as flexible endoscopes are ≥ 2.4% glutaraldehyde, 0.55% OPA, 0.95% glutaraldehyde with 1.64% phenol/phenate, 7.35% hydrogen peroxide with 0.23% peracetic acid, 1.0% hydrogen peroxide with 0.08% peracetic acid, and 7.5% hydrogen peroxide.[50] However, users should check for information on germicide compatibility with the device manufacturers. The two products that are most commonly used for reprocessing endoscopes are glutaraldehyde and an automated, liquid chemical sterilization process that uses peracetic acid.[51]

It is recommended that the endoscopes should be immersed in 2% glutaraldehyde at 20°C for at least 20 minutes for high-level disinfection.[9, 52-61]

The American Society for Gastrointestinal Endoscopy (ASGE) recommends glutaraldehyde solutions without surfactants because the soapy residues of surfactants are difficult to remove during rinsing.[52] Ortho-phthalaldehyde has started replacing glutaraldehyde because it possesses many advantages as compared to glutaraldehyde. Iodophors, chlorine solutions, alcohols, quaternary ammonium compounds, and phenolics have not been FDA cleared and therefore should not be used for reprocessing endoscopes.[62] Flexible endoscopes are not generally sterilized by ETO because of its lengthy process and aeration time.

Biopsy instruments are considered as critical items and are difficult to clean. Therefore, single use disposable biopsy instruments are recommended. However, if they are not available, these must be steam sterilized. Some newer models of flexible and rigid endoscopes can withstand steam sterilization. Hence, being critical items, it would be preferable to steam sterilize them as compared to high-level disinfection.

To summarize, endoscope disinfection or sterilization with a liquid chemical sterilant involves following steps:

1. Testing the endoscope for leaks before immersion in the disinfectants.
2. Mechanically cleaning internal and external surfaces, including brushing internal channels and flushing each internal channel with water and a detergent or enzymatic cleaner.
3. Immersing endoscope in high-level disinfectant or chemical sterilant.
4. Perfusing disinfectant into all accessible channels such as the suction/biopsy channel and air/water channel.
5. Exposing the equipment to the disinfectant for a specific time recommended for that product. This eliminates air pockets and ensures contact of the germicide with the internal channels.
6. Rinsing the endoscope and all channels with sterile water or filtered water. Use tap water if sterile or filtered water is not available.
7. Drying by rinsing the insertion tube and inner channels with alcohol followed by drying with forced air after disinfection and before storage.
8. Storing the endoscope in a way that prevents recontamination and promotes drying e.g., hanging vertically.

In addition to the endoscope reprocessing steps, a protocol should be developed that assures that the user knows whether an endoscope has been appropriately cleaned and disinfected e.g., using separate room or cabinet for processed or unprocessed endoscopes. Confusion can result when users leave endoscopes on movable carts and it is unclear whether the endoscope has been processed or not. Unfortunately, audits have shown that personnel do not adhere to guidelines on reprocessing[63-65] and outbreaks of infection continue to occur.[66-68] In order to ensure that reprocessing personnel are properly trained, there should be initial and annual competency testing for each individual who reprocesses endoscopic instruments.[69, 70]

DISINFECTION AND STERILIZATION OF EQUIPMENT RELATED TO OBSTETRICS AND GYNAECOLOGY

Disinfection strategies for other semi-critical items e.g., rectal or vaginal probes used in sonographic scanning, cryosurgical instruments, and diaphragm fitting rings are very limited and highly variable. Currently, FDA requests that the device manufacturer include at least one validated cleaning and disinfection/sterilization protocol in the labelling for their device. As with all medications and devices, users should be familiar with the label instructions.

One diaphragm fitting ring manufacturer recommends that a soap-and-water wash followed by a 15-minute immersion in 70% alcohol should be done.[71] Though alcohols are not classified as high-level disinfectants because their activity against picornaviruse is somewhat limited, this disinfection method should be adequate to inactivate HIV, HBV, and HSV.[72] There are no data on the inactivation of human papilloma virus by alcohol or other disinfectants because in vitro replication of complete virions has not been achieved. Therefore, while alcohol for 15 minutes should kill pathogens of relevance in gynaecology, there are no clinical studies that provide direct support for this practice.[1]

Vaginal probes are used in sonographic scanning. All endocavitary probes including vaginal probe, without a probe-cover, are semi-critical items as they have direct contact with mucous membranes e.g., vagina, rectum, pharynx. However, some guidelines also propose that a new condom/probe cover should be used to cover the probe for each patient, but still, since condoms/probe covers may fail,[73-76] high-level disinfection of the probe also should be performed.

It has also been reported that that condoms were found to be superior to commercially available probe covers for covering the ultrasound probe.[77] These studies underscore the need for routine probe disinfection between examinations. Although most ultrasound manufacturers recommend the use of 2% glutaraldehyde for high-level disinfection of contaminated transvaginal transducers, the use of this agent has been questioned[78] because it may shorten the life of the transducer and may have toxic effects on the gametes and embryos.[79] An alternative procedure for disinfecting the vaginal transducer has been suggested.[80] It involves the mechanical removal of the gel from the transducer, cleaning transducer in soap and water, wiping the transducer with 70% alcohol or soaking it for 2 minutes in 500 ppm chlorine, and rinsing with tap-water and air drying.

High-level disinfection with a product e.g., hydrogen peroxide, that is not harmful to staff, patients, probes and retrieved cells, should be used until the time when effectiveness of alternative procedures against microbes

of importance at the cavitary site is proved and validated by well-designed experimental scientific studies. Other probes such as rectal, cryosurgical, and transesophageal probes/devices should also be subjected to high-level disinfection between patients, as suggested above.[1]

Ultrasound probes may also be used during surgical procedures and have contact with sterile body sites. Sterile sheaths can be used to cover these probes to reduce the level of contamination on the probe and risk of infection. However, since the sheath does not provide complete protection, the probes should be sterilized between each patient use, as with other critical items.[1]

Those parts or items that can not be immersed in the disinfectants can be wrapped with a cloth soaked in a high-level disinfectant in order to allow the recommended contact time.

As with all other high-level disinfection procedures, proper cleaning of probes is absolutely necessary for the reasons as mentioned earlier to ensure the success of the subsequent disinfection.

QUALITY CONTROL[81]

Proper sterilization of instruments and equipment is a critical component of infection control. Since sterilization cannot be ensured by the naked eyes, indirect methods are used to determine sterilization e.g., monitoring time, temperature and sterilant contact. As sterilization processes has become more sophisticated now, more scientific monitoring is practiced.

A quality control program involves the use of the following:

Mechanical/Electronic Indicators

Mechanical and electronic indicators are easy to use and interpret, and they are the earliest indication of unsatisfactory sterilization conditions. Sterilizers are equipped with time, temperature and pressure gauges. These readings have limited role since they indicate what is happening at the probe site and not inside the packs being processed. These readings should be reviewed and recorded after each and every sterilization cycle. Older sterilizers use analog (mechanical) controls, while newer sterilizers usually incorporate digital (electronic) controls, which are much more reliable. Newer digital monitoring systems are also available that monitor all the parameters of the sterilization process through a real time system with adjustable alarms to alert the user for any changes in the parameters. These systems also graph the physical parameters of the sterilization process that can be visually observed by the user.

Chemical Indicators

Chemical indicators are those that change their characteristics on being exposed to one or more process parameters. According to Association for the Advancement of Medical Instrumentation (AAMI) standard, an external and an internal chemical indicator should be used with every pack.
Chemical indicators can be classified as follows:

Class I—Process indicators are in the form of tape or labels, for external use to show whether an item has been processed or unprocessed.

Class II—Bowie-Dick indicators are used to show the pass/fail test in pre-vacuum steam sterilizers. The indicator sheet is placed inside a towel pack that indicates the presence of air after the sterilizer performs pre-sterilization air removal. AAMI standard state that the Bowie-Dick test must be carried out each day the vacuum steam sterilizer is used in an empty chamber.

Class III—Temperature-specific-indicators signify the attainment of specific minimum temperature at a location within the chamber where they are placed. These are not sensitive to other sterilization parameters.

Class IV—Multi-parameter indicators provide an integrated response to all the parameters needed to achieve sterilization by either a specified colour change or migration along a wick.

Class V—Integrating indicators react to all critical parameters over a specified range of sterilization cycles.

Biological Indicators

Biological indicators are a preparation of living micro-organism along with spores. These provide highest level of sterility assurance because they actually test the ability to kill specific strains of highly resistant organisms. Biological indicators are non-pathogenic and are specific for the type of sterilization process being monitored. They are available in following types:

Spore strips—After processing, the spore strip envelope is opened and the biological indicator is aseptically transferred to a tube of sterile culture media, and then incubated for seven days.

Self-contained vials—A glass ampoule of sterile media is surrounded by a plastic vial with a spore strip inside. After processing, the user activates the biological indicator by crushing the vial to let the media come into contact with the spore strip, then incubating at the appropriate temperature.

Sealed glass ampoules—In this form the spores and media are mixed together, spore growth will usually occur in 8 to 12 hours.

Biological indicators are placed inside a test pack in a fully loaded chamber in the area of the sterilizer that is least favourable to sterilization. Biological indicator testing varies among users and suppliers, however it should be done at least weekly or whenever artificial prosthesis is sterilized. A rapid biological indicator based on detection of an enzyme bound to spores is also available to be used with high-speed steam sterilizers; the results can be obtained with in 1-4 hours. If any of the processed biological indicators is cultured positive, then cause of failure should be determined and corrected, re-sterilization of all suspected non-sterile items should be done.

Sterilizer Maintenance

All sterilization equipment must receive periodic and routine maintenance to ensure accurate and reliable operations. Daily inspections and cleaning along with preventive maintenance in accordance with manufacturer's recommendations should be done. Qualified personnel must carry out periodic calibration of gauges, timers, recording and control devices.

Record Keeping

Record keeping is considered an absolute essential for any facility involved in the sterilization of instruments and materials for disbursement. Record should be kept of each and every sterilizer's performance. Maintenance records must be kept showing the details such as model and serial number of each sterilizer, date of servicing, reason for service request, work done etc. Documentation assures that the monitoring of the sterilization process is occurring and cycle parameters have been met to establish accountability.

All sterilization records should include:

1. Date, sterilizer number and load number
2. General contents of load
3. Exposure time, temperature and pressure
4. Operator's name
5. Chemical indicator result
6. Biological indicator result
7. Bowie-dick test result.

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Section IV

Vulval Surgery

16 Vulval Disorders (Non-neoplastic and Premalignant), Biopsy Techniques and Wide Local Excision

Sudha Prasad, Shakun Tyagi

INTRODUCTION

Vulval disorders ranging from benign conditions such as fungal infections to preneoplastic lesions or superficially invasive carcinoma have similar presentation. Many a time even ominous lesions are asymptomatic. In such a situation best management will depend on timely reporting by the patient and careful examination and early biopsy/ referral by the health care provider. Delay in diagnosis must be avoided and less than optimal treatment may result in poor prognosis if the lesion is malignant. On the other hand too aggressive a treatment for a benign, preneoplastic or superficially invasive vulvar carcinoma will result in local disfigurement, adversely affect sexual function and self-image. Therefore, there has been recent trend towards more conservative treatment.

International Society For Study Of Vulval Disorders (ISSVD) Classification of Non-Neoplastic Epithelial Disorders of Vulva[1]

1. Lichen sclerosus
2. Squamous cell hyperplasia
3. Other Dermatoses, e.g. Paget's disease, lichen planus, psoriasis.

Non-neoplastic Epithelial Disorder

Lichen Sclerosus

Lichen sclerosus is a chronic and inflammatory skin disease of uncertain etiology. The disease appears to be familial and is associated with other autoimmune diseases. Vulval itching of varying intensity is the main symptom. Clinically, there is vulval depigmentation and the lesion often extends to perianal region forming a figure of 8-shape. In case of atrophic type of lichen sclerosus, there is loss of labia minora, entrapment of the clitoris and formation of labial or fourchette adherence. Although in more than 60% of cases of squamous carcinoma of vulva lichen sclerosus can be present in adjacent areas. Only 4 to 6%[2,3] patients of lichen sclerosus eventually develop squamous cell carcinoma. Any white plaques, erosions, ulcers or nodules should be biopsied. Histologically lichen sclerosus is characterized by epidermal atrophy, hyalinized superficial dermis, and underlying lymphocytic infiltration (Fig. 16.1).

Squamous Cell Hyperplasia

Squamous cell hyperplasia is a chronic reactive disorder to conditions such as lichen sclerosus, psoriasis, lichen planus, lichen simplex chronicus, eczema, seborrheic dermatosis, HPV and candida infection. The underlying cause of squamous hyperplasia needs to be properly identified and treated. Pruritus is the main presenting complaint. Histologically squamous cell hyperplasia is characterized by epithelial thickening (hyperplasia), thickening of the keratin layer (hyperkeratosis), elongation and widening of the epithelial rete ridges (acanthosis), and retention of nuclear material in the keratin layer (parakeratosis). It is associated with vulval carcinoma but not considered to be causal; any potential for malignancy relates to the underlying disease.

Lichen Planus

Lichen planus is an inflammatory, autoimmune, mucocutaneous disorder with multiple clinical variants that may involve both keratinized skin and mucosal surfaces including scalp, nails, and mucous membranes

Fig. 16.1: Linched sclerosus of vulva

of the oral cavity and vulva. Hair loss as well as a history of papular lesions on skin surface (ankle, dorsal surface of the hands, and flexor surfaces of the wrists and forearms) may be found. Pruritus vulva is the most common presenting complaint. The most common type with erosive lichen planus is characterized by white striae known as. Wickham's stria.[4] It can be associated with marked architectural destruction, including loss of labia minora, narrowing of the introitus, obliteration of vagina. Diagnosis is made by histopathological examination of the biopsy specimen which shows hyperkeratosis in the areas of keratinized skin, irregular acanthosis with a saw tooth appearance of rete ridges, a prominent granular layer, and basal cell liquefaction. The exact potential for malignant transformation in vulvovaginal lichen planus is not well known. Current recommendations encourage regular vulvovaginal examinations in patients with lichen planus and biopsy of any suspicious lesions such as non-healing ulcerations or persistent hypertrophy in an area that has been treated with appropriate therapy.

Vulval Intraepithelial Neoplasia (VIN)

The three-grade system of the VIN terminology (VIN-I, VIN-II, and VIN-III) adopted by ISSVD in 1986 has been discarded as the concept of a continuum spectrum of VIN was not supported by the evidence of clinicopathologic data. Recent work has shown that there are two types of invasive vulvar cancer. One is related to HPV infection,[5] the other is associated with underlying chronic dermatologic disease process, in most instances in areas of squamous cell hyperplasia associated with lichen sclerosus or lichen planus. Hence it was inferred that there are two different types of precursor lesions of squamous VIN- the HPV related and non-HPV related.

ISSVD (2004) Classification of Squamous VIN[6]

I. VIN usual type **(associated with HPV)**
   1. VIN, warty type
   2. VIN, basaloid
   3. VIN, mixed (warty, basaloid) type

II. VIN differentiated type **(not associated with HPV)**.

According to this classification the term VIN should apply only to histologically "high-grade" squamous lesions (VIN-2 and VIN-3) and the term VIN-1 should no longer be used.

VIN usual type may be warty, basaloid or mixed type. As compared to basaloid VIN, **Warty VIN** shows HPV DNA more frequently on molecular analysis, occurs at a younger age and has a distinct clinical appearance and often presents as multifocal disease. It is less prone to oncogenesis as compared to basaloid type. *Basaloid VIN* occurs at an older age than warty VIN and has a different clinical appearance (a solitary well-demarcated lesion). Many histopathological features present in usual VIN are common to both basaloid VIN and warty VIN. These features are (Fig. 16.2A):

1. Mitotic figures, often abnormal above the basal layers of epithelium.
2. Cellular and nuclear pleomorphism.
3. High nucleo-cytoplasmic ratio.
4. Irregular clumping of nuclear chromatin.
5. Either parakeratosis or hyperkeratosis and presence of pigmentary incontinence might be present.

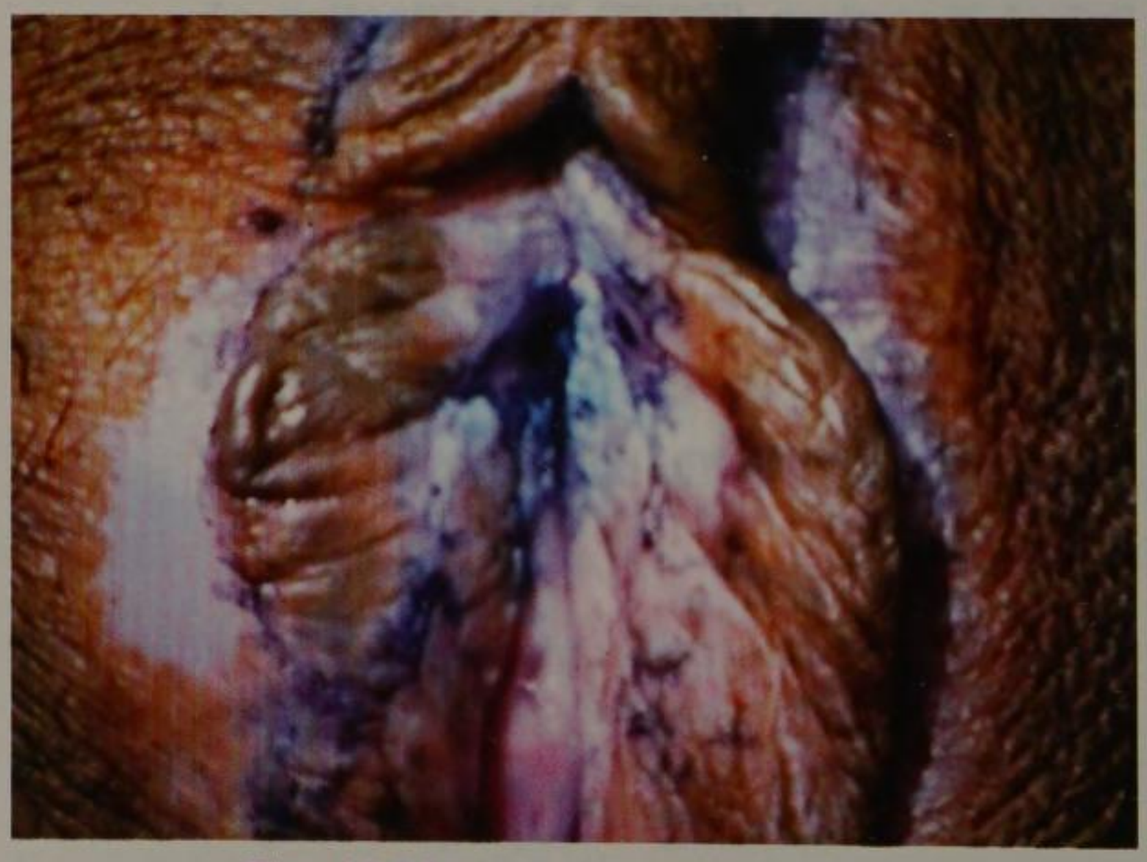

Fig. 16.2A: VIN differentiated type

The differentiating histologic feature between the basaloid and warty VIN is that in basaloid VIN cells of basal or parabasal type extend into the upper layers of the epidermis whereas in warty VIN premature cellular maturation occurs often in association with epithelial multinucieation and koilocytes (perinuclear vacuolation).

Differentiated VIN is observed in vulval epithelium adjacent to invasive vulvar SCC associated with lichen sclerosus. The term "differentiated" refers to the pathologic aspect, which shows basal atypia in the context of a fully differentiated vulval epithelium. Differentiated VIN (non-HPV related) occurring in areas of lichen sclerosus or lichen planus in association with squamous cell hyperplasia has the highest oncogenic potential. Approximately two-thirds of vulvar SCC is not HPV related and develops in the context of chronic inflammation, impaired immunity and epithelial hyperplasia.

Differentiated VIN is characterized by following histopathological features:

1. Epithelium is thickened.
2. Parakeratosis with elongated and anastomosing rete ridges.
3. Little or no atypia.
4. Large eosinophilic keratinocytes with abnormal vesicular nuclei and intracellular bridges are present.
5. Intra epithelial pearls are present in rete ridges.
6. The cells in the basal and para-basal layers are smaller and their nuclei have coarse chromatin and prominent nucleoli.

Paget's Disease of Vulva

Paget's disease of the vulva is a form of intraepithelial neoplasia characterized by the presence within the vulvar epidermis and skin appendages of adenocarcinomatous cells. In approximately 10 to 20% of cases if is associated with underlying adenocarcinoma in the skin adnexal or the bartholin gland. Whether the cells arise in the epidermis and migrate into the adnexa,[7] develop simultaneously in the epidermis and skin appendages[8] or develop in the sweat gland ducts and migrate to the dermis [9-11] is a matter of debate (Fig. 16.2B).

Most patients are elderly, majority being above the age of 60, and their most common complaint is pruritus. Macroscopically there are multiple, erythematous, eczematoid moderately well demarcated, scaly patches or plaques which may be hyperkeratotic and appear white. They commonly involve labia majora but may

Fig. 16.2B: Carcinoma in situ

involve perineum, perianal area or groin. Histopathologically, the paget cells form clusters and nests, with or without tubule formation or lie singly in the epidermis. The paget cells are large or oval and have abundant vacuolated cytoplasm and large, vesicular pale oval or round nuclei some cells may have a signet ring appearance. The affected epidermis may otherwise be normal, acanthotic, hyperkeratotic or parakeratotic. Pagets cells stain positively with mucicarmine adenyle fuschin and alcian blue/PAS after diastase digestion. They also stain positive for other marks such as CEA epithelial membrane antigen.

History and Examination

A detailed history and examination is important in the management of vulval disorders.

1. Presenting complaints, relieving and aggravating factors should be taken in detail.
2. Detailed history of previously administered treatments, response to medications and current treatment.
3. General health including associated medical disorders like diabetes mellitus, hepatic disorders thyroid disorders and autoimmune disorders.
4. History of atopic conditions, dermatoses, sexually transmitted diseases.
5. History of abnormal cervical smears.
6. Psychological disturbance.

Examination should be performed in a well-lit area with a bright examination lamp.

1. *The vulva, mons-pubis, perianal region, vagina and cervix* should be examined and Visual inspection of cervix

after application of 3% acetic acid (VIA) should be performed if cervix is unhealthy.

2. *Colposcopic examination* of cervix, vagina and vulva should be performed in any patient suspected of harbouring preneoplastic or neoplastic lesion of vulva. Application of 3 to 5% acetic acid and 1% toluidine blue is helpful in identifying the site for biopsy.
3. *Toluidine blue test(Collin's test):* One percent aqueous solution of toluidine blue is applied to the vulva from mons pubis to perianal area, bilateral labia majora, minora and introitus. The dye is allowed to dry and then sponged using 3% acetic acid. The whole vulva is carefully viewed for areas retaining toluidine blue dye. A sensitivity for detection of VIN of 92% and specificity of 88% with the use of Colposcope was reported by Jaura.[12] It highlights any raised areas, those with multiple small ulcerations and areas of hyperkeratosis which should be considered for biopsy.
4. *If vulval or perianal intraepithelial* neoplasia extends to within 1.5 cm of the anus, the anal canal should be examined for anal intraepithelial neoplasia (AIN).
5. *Other areas of skin on the body*, including the oral mucosa, should be examined to determine if there is a more widespread skin disorder.

Vulval biopsy and wide local excision are central to diagnosis and optimum management of preneoplastic lesion and superficially invasive vulval carcinoma.

VULVAL BIOPSY

Histopathological examination is gold standard for diagnosis of preneoplastic and neoplastic disorders of vulva.

Indications of Vulval Biopsy

1. Any lesion refractory to therapy, increasing in size or with an unusual warty appearance.
2. Any condyloma that does not respond to therapy.
3. Areas of fissuring, ulceration, induration and thick plaques, areas with hyperkeratosis, or with rough and irregular surface.
4. Any depigmented or pigmented plaques, erosions, ulcers or nodules.

Decision has to be taken regarding—type of biopsy (most appropriate method of taking the biopsy), the site of biopsy and the depth of biopsy.

1. Types of biopsy are:
   a. *Cold knife biopsy*: It can be diagnostic as well as therapeutic in case of small lesions if the entire lesion with adequate depth and entire margin is removed.
   b. *Punch biopsy*: It is to be taken from the area with maximum malignant potential in case of a large lesion/multifocal lesions.
2. *The site of biopsy* in a large or multifocal lesion is difficult to decide. Toluidine blue test may help in deciding the site for biopsy. Raised areas, those with multiple small ulcerations highlighted by toluidine blue test are biopsied. Excision biopsy is recommended in solitary well circumscribed resectable lesion.
3. *Depth of biopsy*: Disease of non hair bearing area requires only 1-2 mm deep biopsy where as lesion on hair bearing areas require a biopsy 4-5 mm deep and extends into the adipose tissue.[13, 14]

Cold Knife Biopsy

It can be performed under local anesthesia. Regional anesthesia or short general anaesthesia might be required if the area to be biopsed is relatively wide in which case local infiltration might prove to be inadequate.

After selecting the site of biopsy the area is prepared with an antiseptic. Incision is given using Bard Parker's handle with an 11 number blade. Incision is given first at the lower margin of the selected area and later extended all around. About 1 cm of clinically, normal margins should be included in the biopsy. The depth should be at least 4 mm in hair bearing area and 2 mm in non-hair bearing area.[13, 14] The tissue is grasped with the help of forceps and the base is cut. Haemostatic stitches are usually required and should be taken in such a manner that normal anatomy is restored as much as possible. While fixing the specimen care should be taken to maintain the orientation and avoid crumpling or folding (Figs 16.3A to C).

Keyes Punch Biopsy

The Keyes Punch Biopsy has a sharpened, round tip, designed to take a vertical core from the epithelium. After selecting the biopsy site, the skin is prepared with an antiseptic. The skin is pinched between the thumb and index fingers to stabilize it. About 2-4 cc of 1% lidocaine is injected sub cutaneously using an insulin needle. While maintaining a good hold on the skin, 4 or 6 mm Keyes

Fig. 16.3A: Cold knife biopsy Step I

Fig. 16.3B: Cold knife biopsy Step II

Fig. 16.3C: Cold knife biopsy taken

punch is directed straight down into the skin. The Keyes punch is rotated, rolling it clockwise and then anticlockwise to assist it in penetrating through the epithelium. This action produces a cylindrical specimen that is very small but descends through the full thickness of the epithelium and into the subcutaneous tissue below. The tissue plug is grasped with the forceps and elevated slightly above the skin. Scissors are used to cut across the base freeing the plug from the subcutaneous tissues.

Bleeding is controlled by applying pressure. If not controlled, Monsel's solution or touching with a silver nitrate stick is helpful. The specimen should be fixed in 45% formaldehyde (formalin) solution and sent for histopathological examination (Figs 16.4A to F).

Excisional biopsy is preferably to Keyes punch biopsy in case of small well-localized suspicious lesions as it can be diagnostic as well as therapeutic.

Treatment of Non-neoplastic and Premalignant Disorders of Vulva

General Advice for all Vulval Disorders

1. Vulval skin is sensitive, and may react to irritants such as soaps. Women should avoid all contact of the vulval skin with soap, shampoo, bubble bath, perfumes, personal deodorants, wet wipes, textile dyes, detergents, fabric conditioners and sanitary wear.
2. Certain types of clothing may make vulval disease (including itching symptoms) worse. Women should be advised to avoid tight-fitting garments that may irritate the area.
3. These patients should avoid use of spermicidal-lubricated condoms.

Lichen Sclerosus (LS)

There is no place for surgery in uncomplicated LS. Surgery should be limited exclusively to patients with malignancy and to correct scarring secondary to the disease.

Treatment is with high potency steroids, e.g. Clobetasol propionate 0.05% (Tenovate). It is applied at the site of the lesion twice daily for one month, then at bedtime for two months and twice weekly for three months. This is followed by application off and on as needed or once or twice a week. Local application of testosterone and oral retinoids-etretinate and acitretine have been investigated in patients who do not respond to local clobetasol application. These druge were

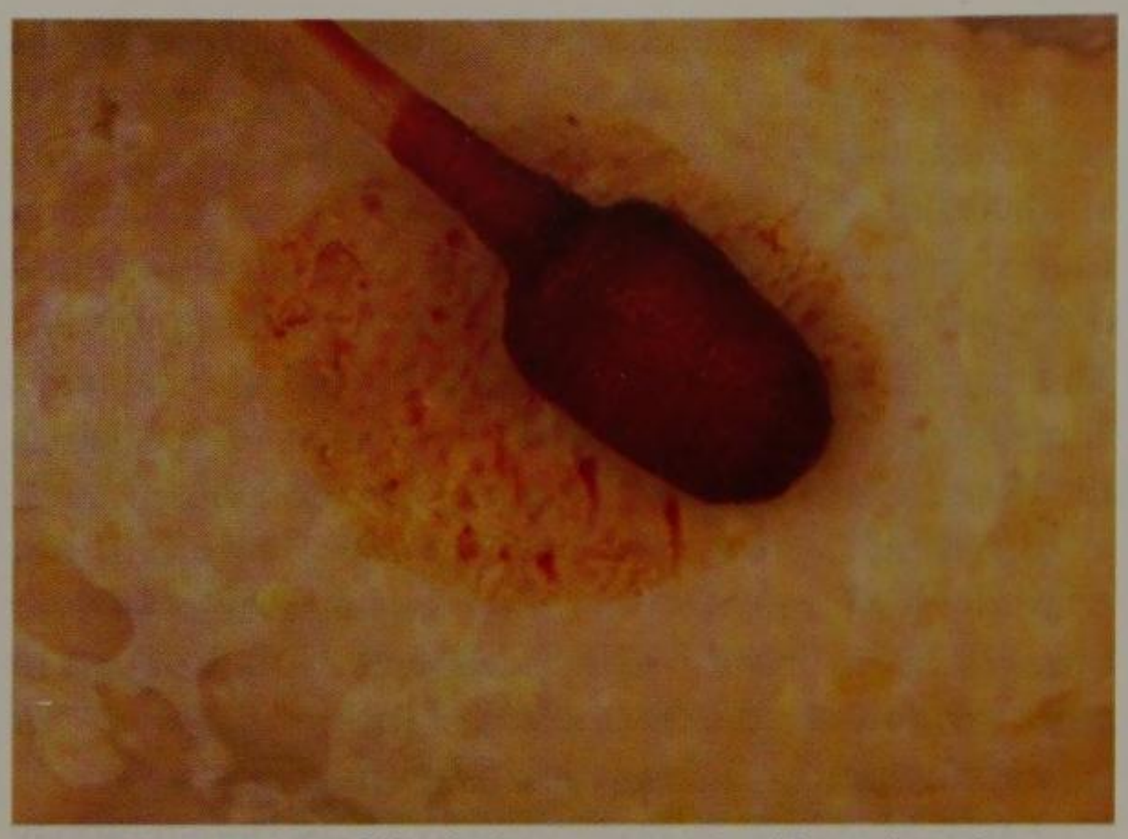

Fig. 16.4A: Skin being prepared with antiseptic

Fig. 16.4B: Skin is being pinched at biopsy site

Fig. 16.4C: Lindocaine is injected with insulin syringe

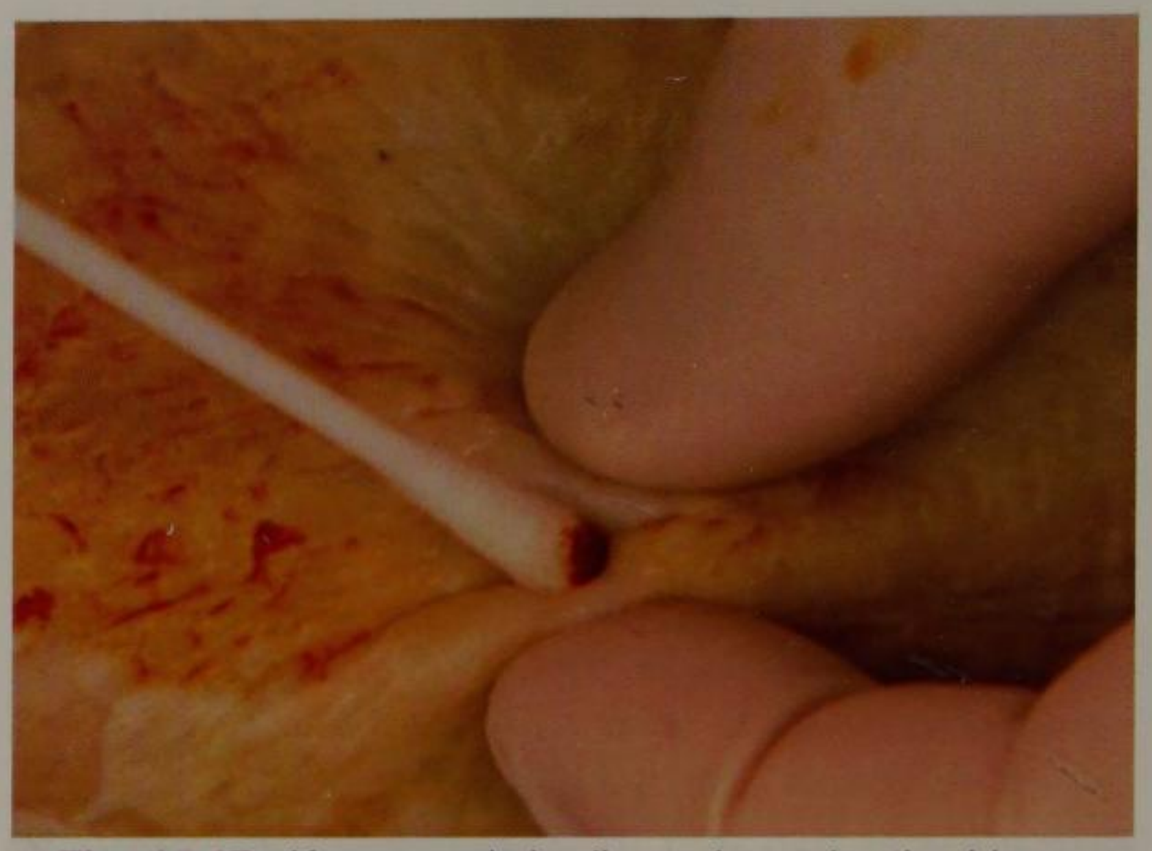

Fig. 16.4D: Keys punch is directed to take the biopsy

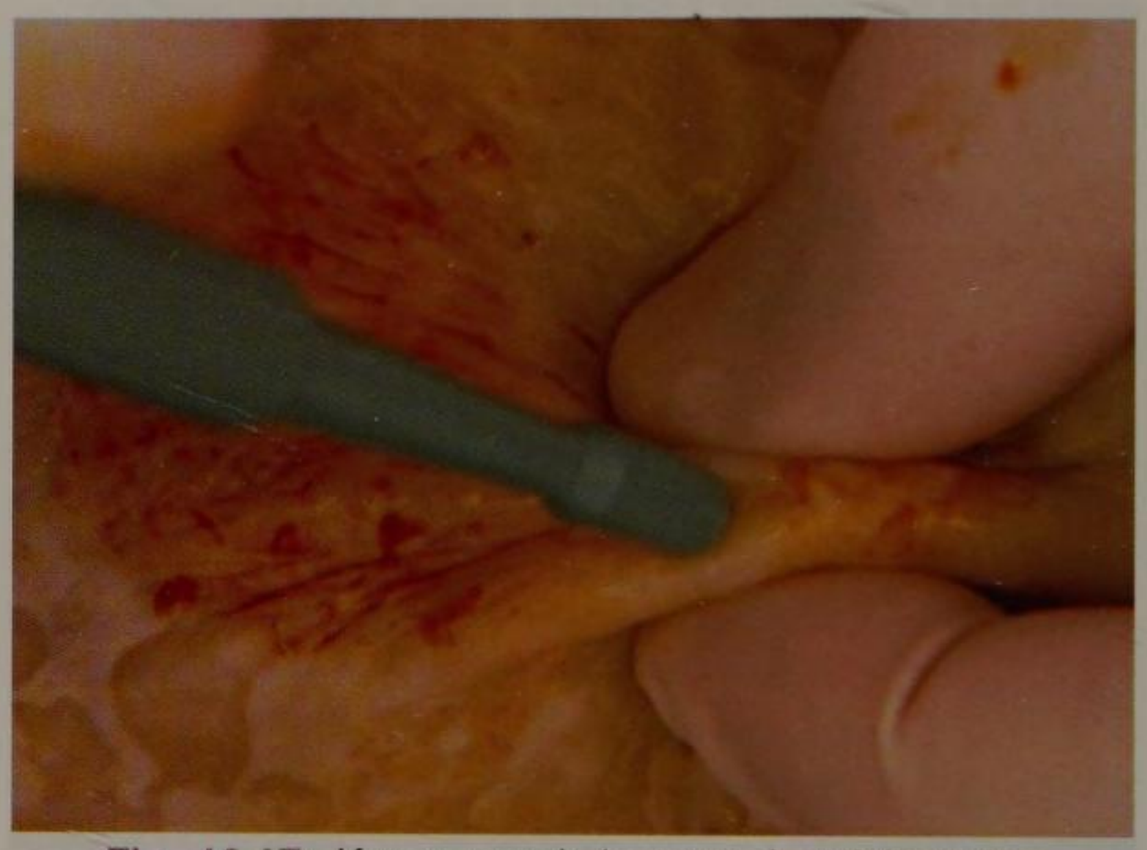

Fig. 16.4E: Keyes punch is rotated anticlockwise

Fig. 16.4F: Tissue plug is being removed

Figs 16.4A to F: Keyes punch biopsy

associated with some response but significant side-effects. Immunomodulators—Tacrolimus and Pimecrolimus are being evaluated for effectiveness in patients with LS. The patient should be warned of the danger of malignancy and the presence white plaques (hyperkeratosis), erosions, ulcers or nodules lesion must be considered for biopsy or excision.

Squamous Cell Hyperplasia

It is important to properly identify and treat the underlying cause of squamous hyperplasia. However, it is not always possible to accurately pinpoint the underlying etiology as the reactive changes due to chronic irritation might mask the features of the basic pathology. Syptomatic treatment is provided by application of medium-strength topical steroids (e.g. betamethasone 0.1%, triamcinolone ointment 0.1%) twice daily until symptoms are controlled, usually in 10 to 14 days. It is used episodically as necessary thereafter. If unsuccessful, high-potency steroids (e.g. clobetasol 0.05%) can be used in a similar fashion with return to a less potent steroid once a response is obtained.

Lichen Planus of Vulva

The vulvar and vaginal lesions of Lichen planus are frequently persistent and resistant to current therapy. Topical potent and ultrapotent corticosteroids, e.g. fluocinonide 0.05%, clobetasol propionate.05% are first line of management. The drug is applied twice daily till the active lesions resolve and then the frequency of application and/or the potency of the topical steroid is gradually tapered. Daily use of corticosteroids should not exceed three months. Topical immunosuppressant macrolide Tacrolimus that inhibits T-lymphocyte activity by inhibiting interleukins 2, 4 and 6 has been investigated and reported to be useful in treatment of lichen planus.[15-17] Systemic medications are reserved for those patients who fail to respond to topical medications or those with extensive disease affecting multiple body sites.

Surgery is not recommended for active lichen planus but it might be required for restoring sexual function when there is severe scarring of vulva or vagina secondary to lichen planus.

Vulval Intraepithelial Neoplasia (VIN)

A balance has to be maintained between adequate treatment as VIN is a precursor of a potentially lethal condition, squamous cell vulvar cancer and preservation of local anatomy as disfigurement might affect self-image and also be a cause of dysparunia. Moreover preventive effect of vulvectomy on future development of invasive vulvar cancer is not fully proven.

The various modalities available are:

Local excision: Surgery is the mainstay of VIN therapy. Excision can be performed with the help of scalpel, electro surgery or laser therapy. It should allow at least 5 mm of disease free margins and preservation of uninvolved structures. The depth should be at last 2 mm in non-hair bearing areas and 4 mm in hair bearing areas. As much as possible anatomy should be restored. Excision of clitoris should be avoided. In case of involvement only clitoral prepuce can be removed or VIN can be managed by observation/superficial fulguration or laser evaporation.

VIN differentiated type generally requires a more extensive surgical approach.

Ablation Carbon dioxide (CO_2) laser ablation—is treatment of choice for multifocal extensive disease/clitoral disease.

1. 1.0 mm destruction of non-hair bearing skin is adequate treatment.
2. If skin appendages are involved 2.5-3 mm destruction is required.

Medical management

1. Imiquimod
2. 5-flurouracil cream

These cause severe inflammation in the process (several weeks) and are not tolerated by all patients and are associated with poor patient compliance.

Paget's Disease of Vulva

Extramammary Paget's disease is associated with high rate of recurrence and failure of therapy due to apparently multifocal nature of the disease and tendency of the lesion to extend beyond the clinically apparent margin. Treatment is by *wide local excision*. Peroperative frozen section may be used in order to map the extent of disease. Mohs micrographic surgery (MMS) is a surgical technique for the removal of certain cutaneous carcinomas that allows precise microscopic marginal control by using horizontal frozen sections may be used. When used in cases with extramammary pagets disease MMS lowers the recurrence rates to 8-26% as compared to 30-60%, associated with standard surgical excision. A rapid carcinoembryonic antigen stain may also be used

peroperatively to distinguish between artifactual vacuoles and pagetoid cells which have similar appearance on routine hematoxylin and eosin staining.

Three monthly follow-up for two years after surgery is required to assess possible recurrence. Thereafter annual examination is advocated.

CONCLUSIONS

Pre-neoplastic and neoplastic lesions of vulva are often diagnosed late inspite of being visually approachable. The reasons for the delay are many folds: relatively low index of suspicion non-specific symptoms in the form of itching, burning, and dyspareunia and blood loss which are also compatible with non-neoplastic infective pathology; inadequate examination of the external genitalia by doctors and also delay on the part of patients to seek medical help. Patients should be taught vulvar self- examination with a mirror so that they can closely watch for new lesions or architectural changes. Regular follow-up is an important component of care for patients with chronic vulvar conditions.

Key Points

1. Histopathological examination is gold standard for diagnosis of preneoplastic and neoplastic disorders of vulva.
2. Current recommendations encourage regular vulvovaginal examinations in patients with lichen planus and biopsy of any suspicious lesions.
3. First line of management of lichen planus of vulva is topical potent and ultrapotent corticosteroids. e.g. fluocinonide 0.05%, clobetasol propionate.05%.
4. There is no place for surgery in uncomplicated lichen sclerosus. Surgery should be limited exclusively to patients with malignancy and to correct scarring secondary to the disease.
5. Surgery is the mainstay of VIN therapy.
6. It is important to properly identify and treat the underlying cause of squamous hyperplasia.
7. Cold knife biopsy: About 1 cm of clinically, normal margins should be included in the biopsy. The depth should be at least 4 mm in hair bearing area and 2 mm in non-hair bearing area
8. Keyes punch biopsy produces a cylindrical specimen that is very small but descends through the full thickness of the epithelium and into the subcutaneous tissue below.
9. Excisional biopsy is preferably to Keyes punch biopsy in case of small well-localized suspicious lesions as it can be diagnostic as well as therapeutic.
10. Carbon dioxide (CO_2) laser ablation—is treatment of choice for multifocal extensive disease/ clitoral disease.
11. Extramammary Paget's disease is associated with high rate of recurrence and failure of therapy due to apparently multifocal nature of the disease and treatment is by wide local excision.

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17 Hymenectomy, Labial Fusion Release, Introital Widening, Schuchardt's Incision

Neerja Goel, Rajni Gill

HYMENECTOMY

Hymen anomalies like imperforate hymen, annular hymen, septate hymen are not uncommon .Imperforate hymen is a congenital condition which presents with symptoms of cryptomennorhea, intermenstrual discomfort, abdominal mass and occasionally urinary or bowel symptoms produced by dilated vagina. Septate and annular hymen usually results in dyspareunia, infertility and obstructed labour. These symptoms are effectively relieved by a simple surgical procedure called hymenectomy.

Definition

Excision of the hymen is known as hymenectomy.

Patient Selection and Indications

1. Childhood—To drain mucus secretion of uterus (mucocolpos).
2. Adolescence—To drain blood/endometrial secretions (hematocolpos) (Figs 17.1 and 17.2).
3. Adulthood—To excise hymen in case of incomplete vaginal membrane causing dyspareunia, infertility or obstructed labour.

Operative Procedure

A cruciate incision is given in the centre of hymen in case of imperforate hymen.

While in annular hymen incisions are given at 2, 4, 8 and 10 o' clock positions.[1]

Hymen tissue is excised leaving a fringe of tissue about 2 mm away from the mucosal margin. Mucosal margins are approximated with fine delayed absorbable suture (Fig. 17.3).

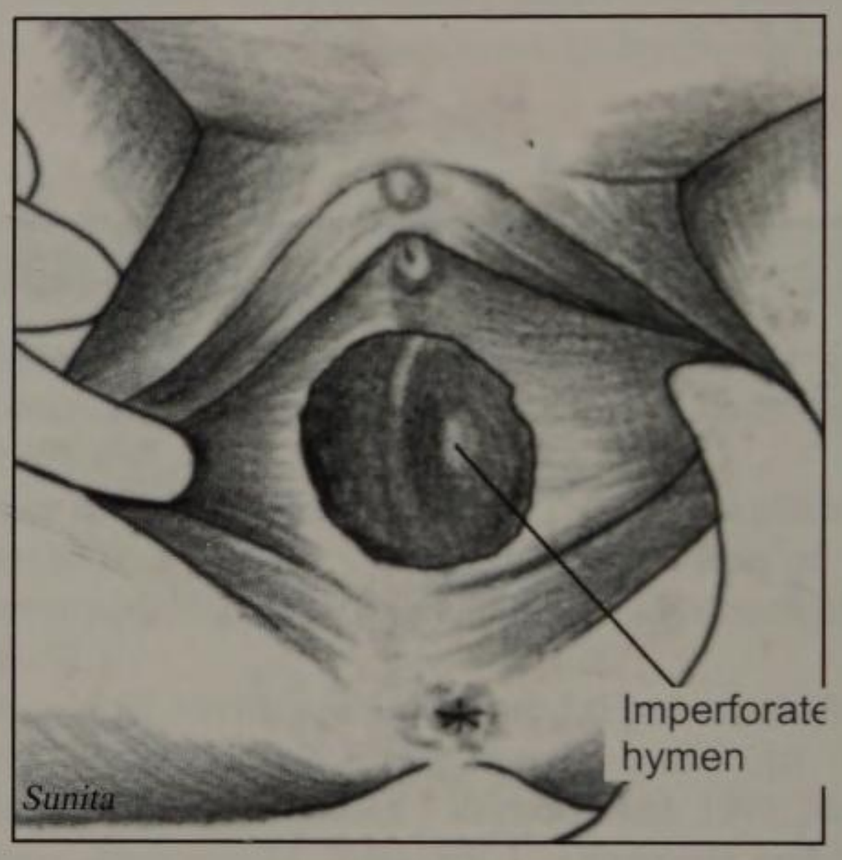


Fig. 17.1: Imperforate hymen, classic appearance of bulging, blue-domed, translucent membrane

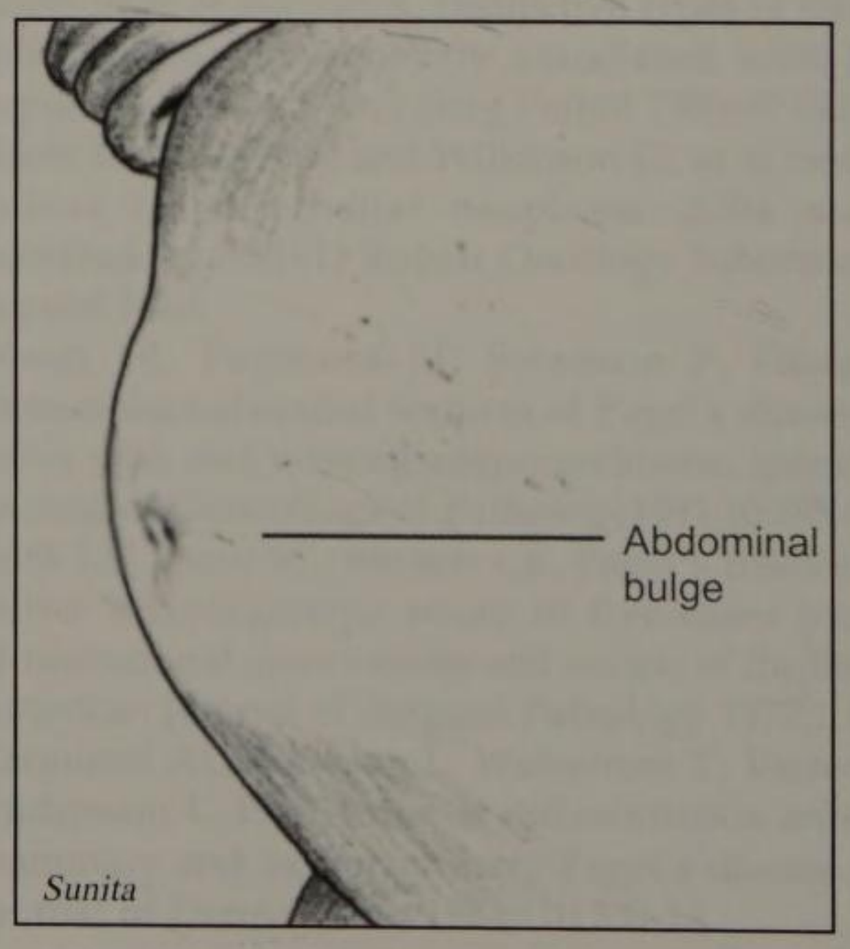


Fig. 17.2: Abdominal mass with imperforate hymen

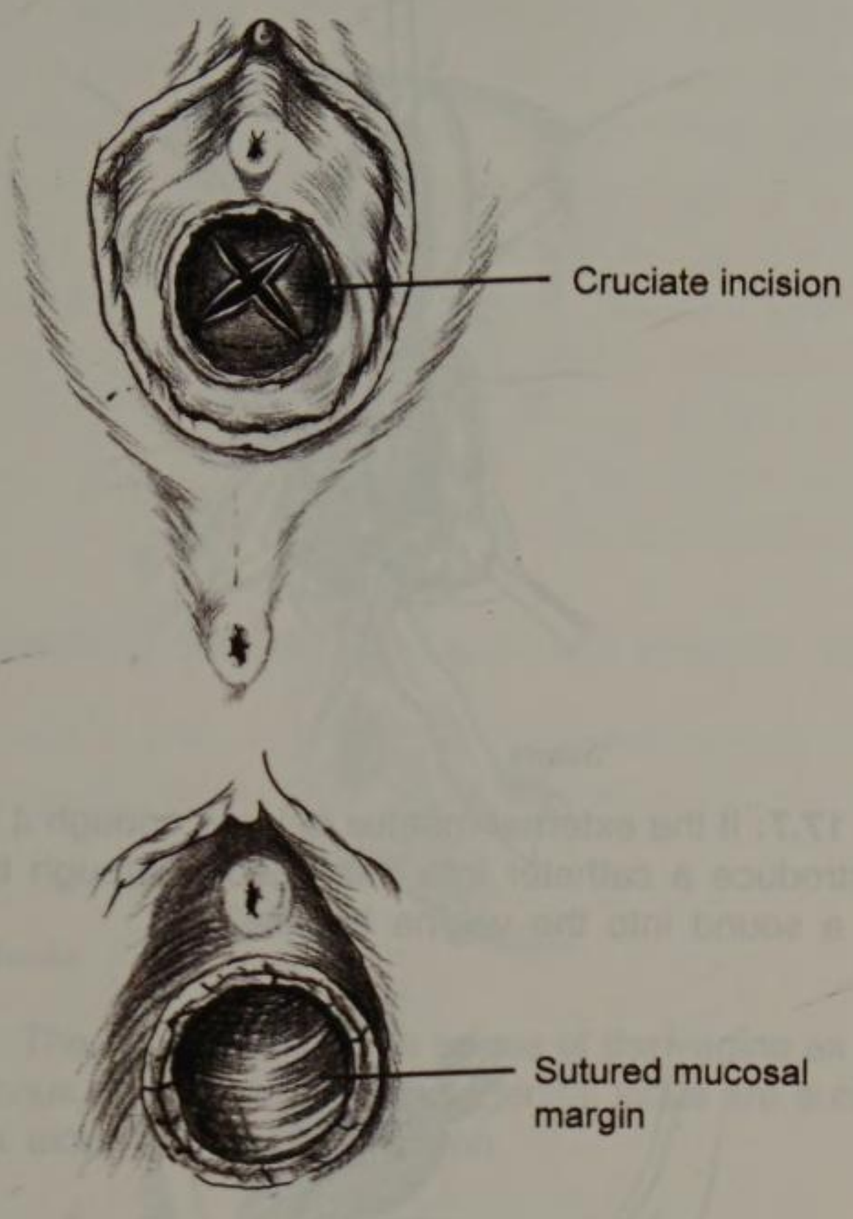


Fig. 17.3: Excision of imperforate hymen

Precaution

Excision of the hymenal tissue too close to mucosal lining can lead to scarring and stenosis.

Postoperative Management

1. Anti-inflammatory drugs and antibiotics are given for a week.
2. Patient is advised to wear clean cotton undergarments with a sterile pad.
3. No antiseptic dressing or vaginal douching is required.

Complications

1. Incomplete drainage and failure of marsupilization may result in recurrent obstruction and in ascending pelvic infection.
2. Unnecessary instrumentation of uterus may lead to perforation of uterus.

LABIAL FUSION RELEASE

Labial fusion is a congenital anomaly which is usually noticed by parents in early childhood. Its treatment varies from simple release to complex urogenital reconstruction.

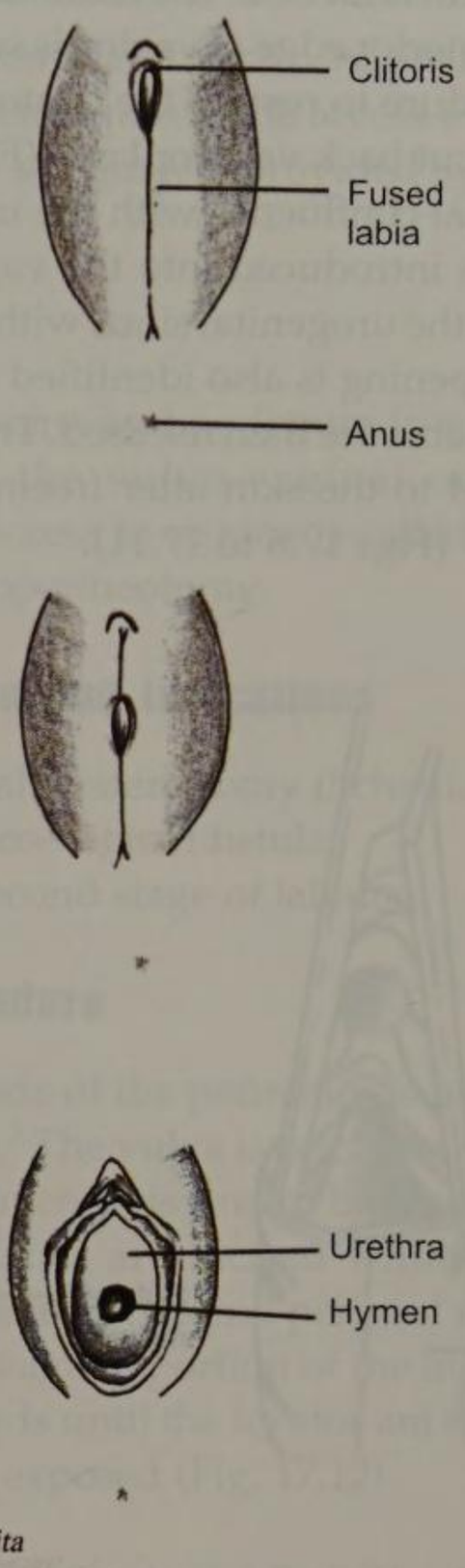


Fig. 17.4: Coagglutination of labia minora

Definition

Surgical procedure aimed to release fusion of genital labia.

Patient Selection and Indication

1. Simple coagglutination of labia minora (Fig. 17.4).
2. Simple fusion of labia majora as seen in adreno genital syndrome
3. Low vaginal confluence with the urogenital sinus.

Operative Procedure

1. Coagglutination of labia minora—A silver probe is used to separate the labia minora. Antibiotics and anti-inflammatory drugs along with non-adhesive dressing are given for a week.[2]

2. Labia majora fusion—Fused labia which resembles bifid scrotum is incised. The redundant skin is excised and the posterior edge of vagina is sutured to the skin. This procedure to restore the contour of the vulva is known as cut back vaginoplasty (Fig. 17.5).
3. Low vaginal confluence with the urogenital sinus—A sound is introduced into the vaginal orifice after inspecting the urogenital sinus with a panendoscope. Urethral opening is also identified and catheterized. The fused labia are then released. The edges of vagina are sutured to the skin after freeing it laterally and posteriorly (Figs 17.6 to 17.11).

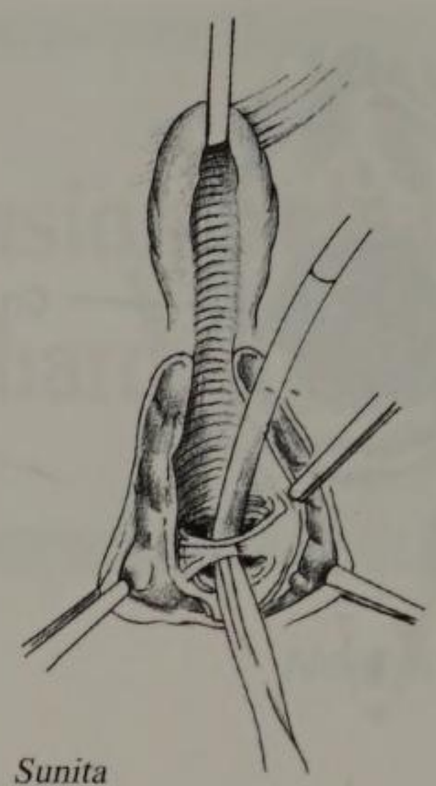


Fig. 17.7: If the external meatus is large enough it is possible to introduce a catheter into the bladder through the urethra and a sound into the vagina beside this

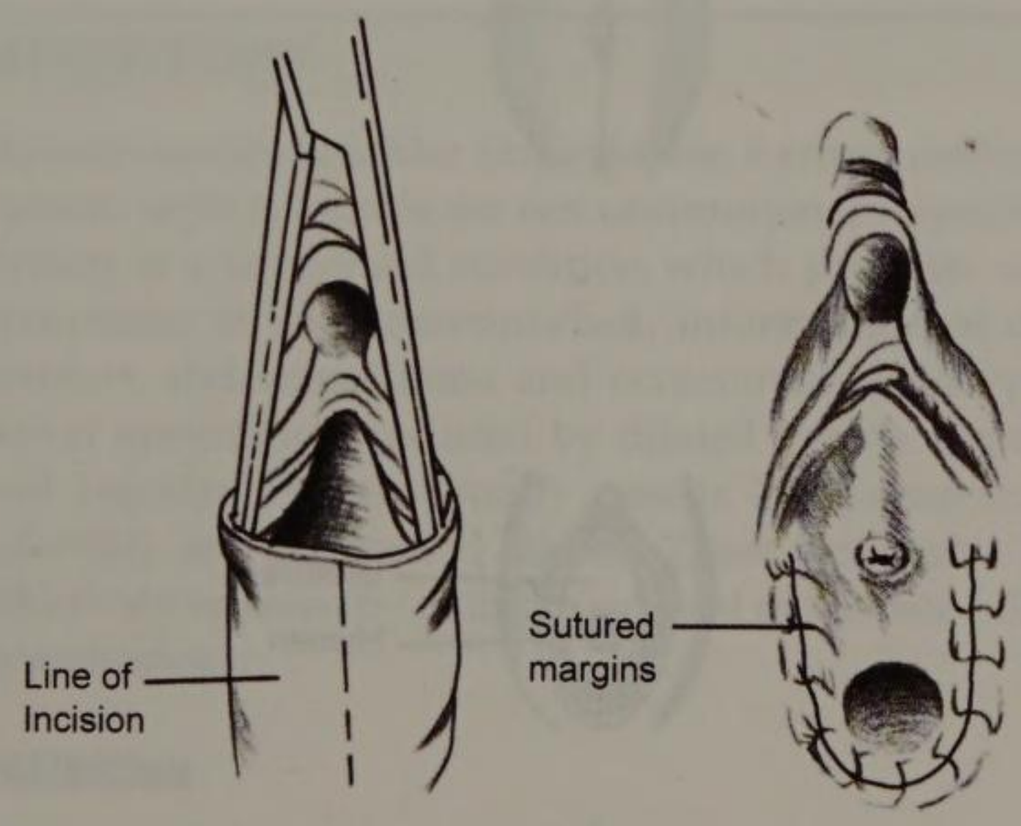


Fig. 17.5: Cut back vaginoplasty

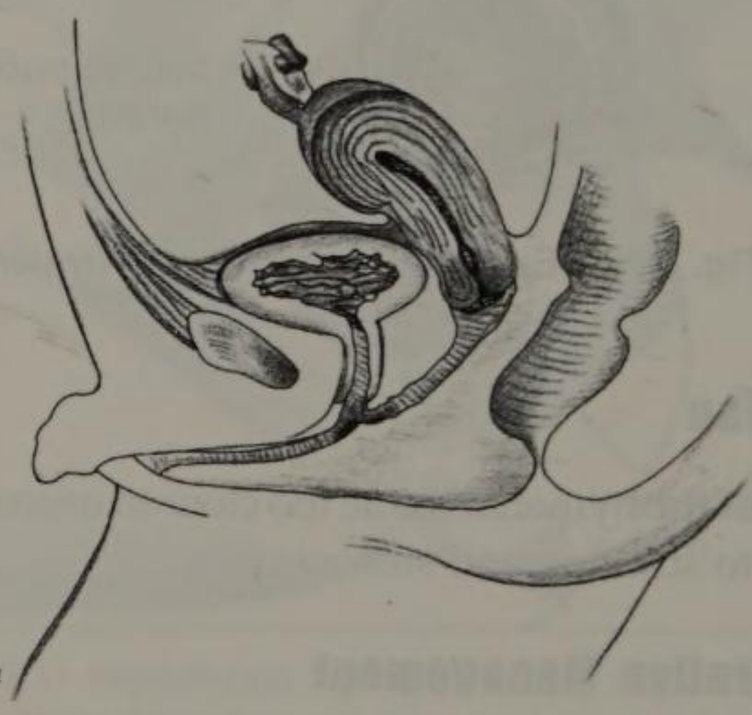


Fig. 17.8: Lateral view showing the relation among different structures

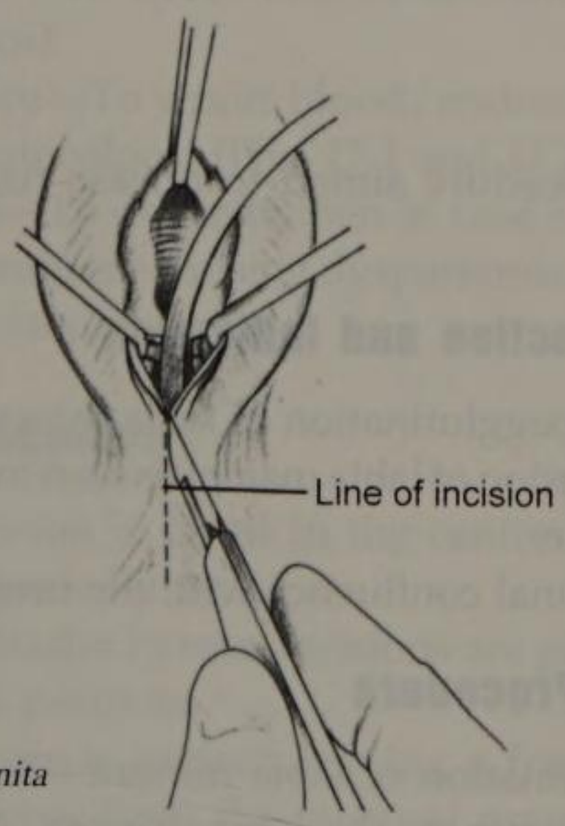


Fig. 17.6: Incision into the uro-genital sinus

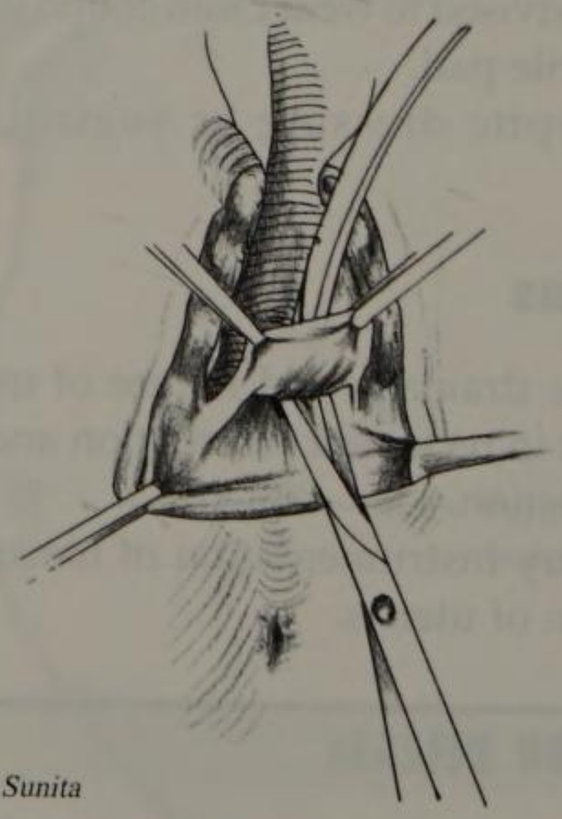


Fig. 17.9: The posterior vaginal wall is freed to make it possible to bring it to the skin edge without undue tension

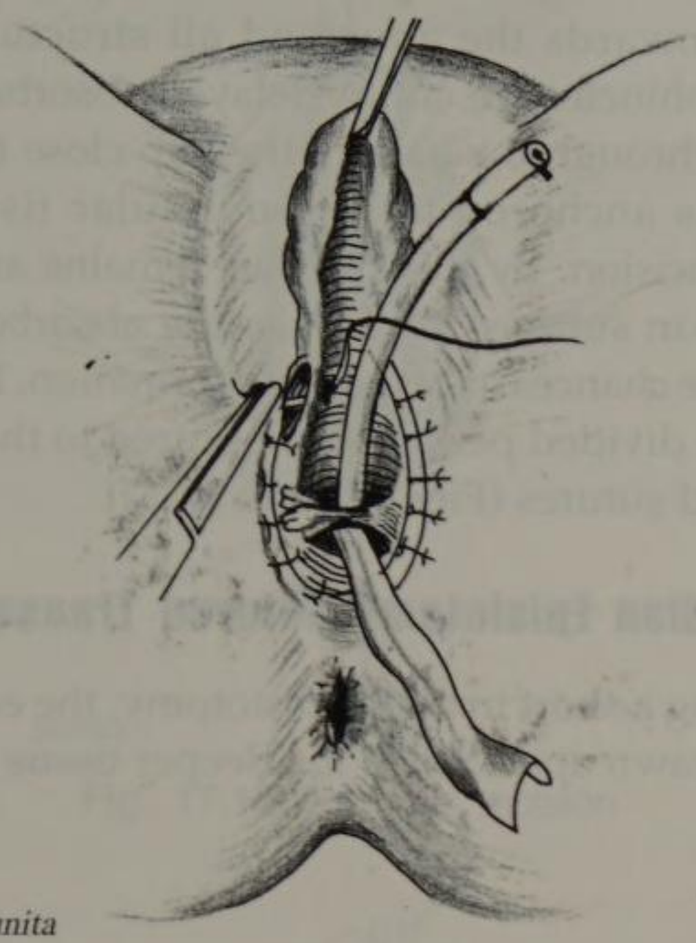


Fig. 17.10: The situation after the edges of the vagina as well as the mucous membrane of the urogenital sinus are sutured to the skin along the line of incision

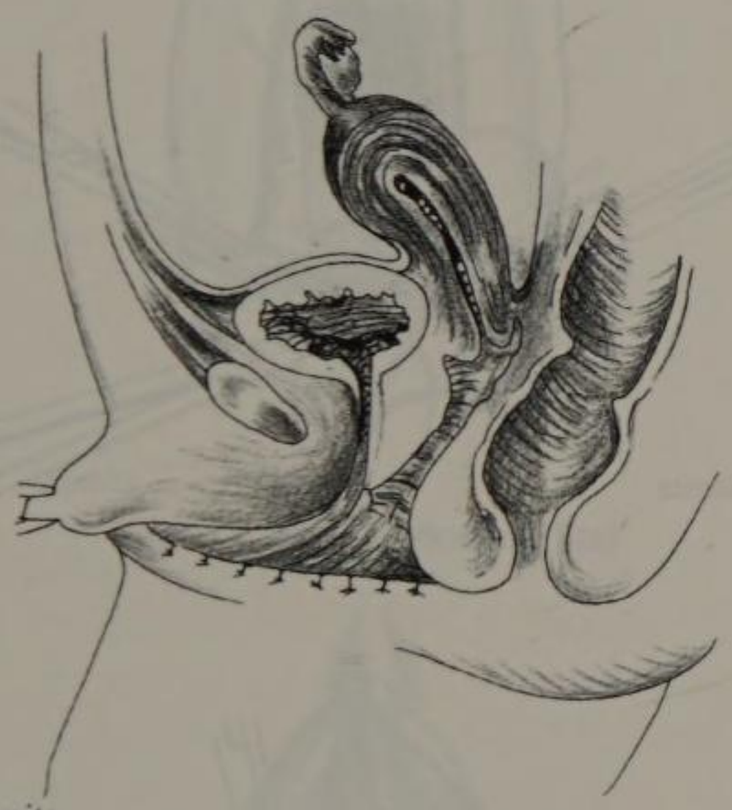


Fig. 17.11: Lateral view at the completion of the procedure

Postoperative Management

1. Adequate analgesia and antibiotics are given.
2. A small sponge impregnated with petroleum jelly is introduced into the vagina to maintain its patency during healing in urogenital confluence
3. Indwelling urinary catheter is left in place for 48 hours.
4. Pressure dressing for 24 hours is given to reduce the chances of haematoma formation.

SCHUCHARDT'S INCISION

Radical hysterectomy and vesico-vaginal fistula repair are surgeries which require wide access to lower genital tract. This is quite adequately provided by Schuchardt's incision.

Definition

Incision of the vagina and perineum in order to secure enlargement of the vulvo-vaginal outlet thereby permitting easy access to vagina is called Schuchardt's incision or vaginoperineotomy.

Patient Selection and Indications

1. Radical vaginal hysterectomy (Schauta's operation).
2. Repair of vesico-vaginal fistula.
3. To facilitate second stage of labour.

Operative Procedure

The skin on left side of the perineum is incised at about 4 o'clock position.[3] The vulva is retracted with a vaginal retractor and the rectum is drawn backwards. Skin and subcutaneous tissues are incised while more deeply transverse perineal muscles and perineal membrane are cut through. The vaginal portion of the incision is made about 4 cm upwards until the levator ani muscle with its covering fascia is exposed (Fig. 17.12).

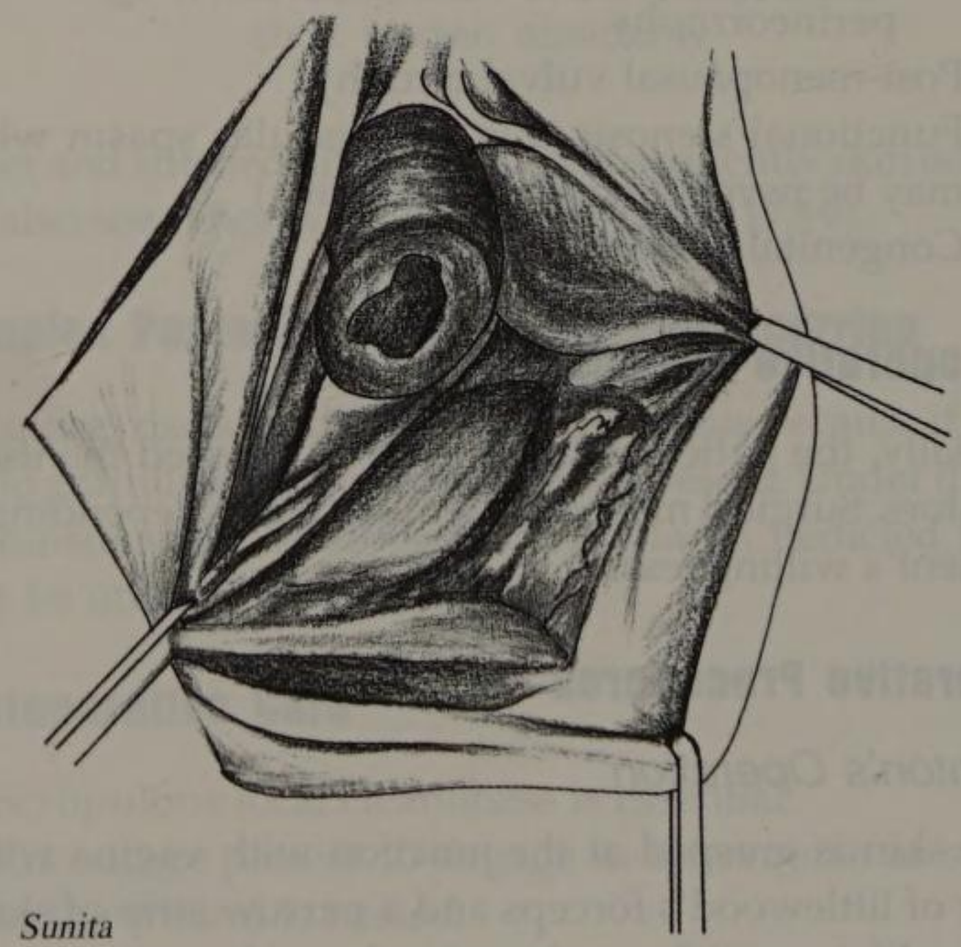


Fig. 17.12: Schuchardt's incision

Precaution

Bleeding vessels must be secured to prevent hematoma formation.

Complications

Damage to rectum is the only danger which can be avoided by retracting the rectum backward well away from the incision.

INTROITAL WIDENING

Stenosis of introitus carries not only sexual but also psychological and emotional implications. Hence, it should be diligently managed.

Definition

It is an operative technique to widen the introitus in order to facilitate the act of sexual intercourse.

Patient Selection and Indications

1. Iatrogenic Introital Stricture
   a. Inexpert suturing technique following child birth injury, perineal laceration or episiotomy. It mainly occurs due to failure to recognize concurrence of a partial annular or circumferential tear of posterior vestibule which if sewn up as a single vertical repair narrows the introitus.
   b. Excessive reduction of introital size during perineorraphy
2. Post-menopausal vulval atrophy.
3. Functional stenosis due to muscular spasm which may be psychological (Vulvodynia)
4. Congenital stenosis.

Preoperative Preparation

Initially, the patient must always be advised the use of dilators. Surgical means are required only depending on patient's willingness.

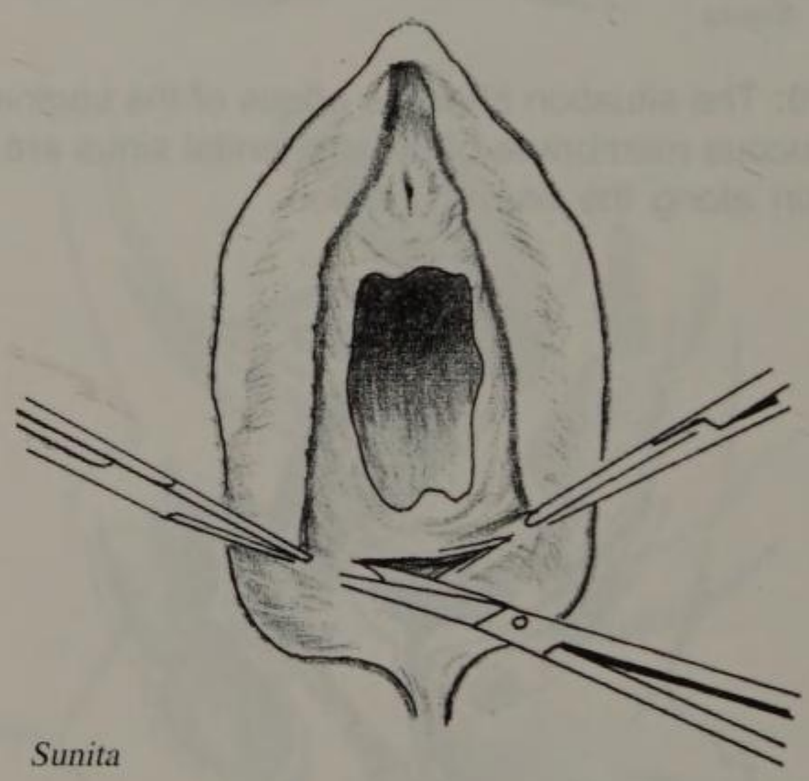
Operative Procedures

Fenton's Operation

The skin is grasped at the junction with vagina with a pair of littlewood's forceps and a narrow strip of skin is incised.[4] A small flap is then developed by under cutting the skin on the vaginal aspect. A vertical perineal incision is made towards the anus and all structures except external sphincter are cut. A delayed absorbable suture is passed through the base of the flap close to the midline and is anchored to fibromuscular tissue of the perineal incision. By this the flap remains anchored in case the skin sutures get too rapidly absorbed. Also, it reduces the chances of hematoma formation. Finally, the skin of the divided perineum is sutured to the flap with interrupted sutures (Figs 17.13 to 17.17).

Short Median Episiotomy Sutured Transversely

After giving a short median episiotomy, the edges of the skin are drawn apart while the deeper tissue is brought



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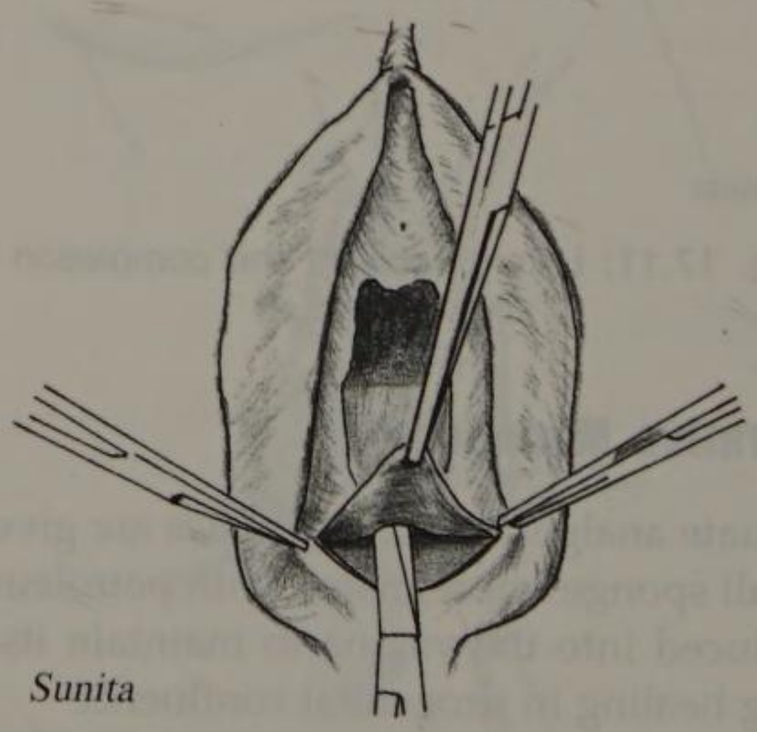

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Fig. 17.14: Development of flap

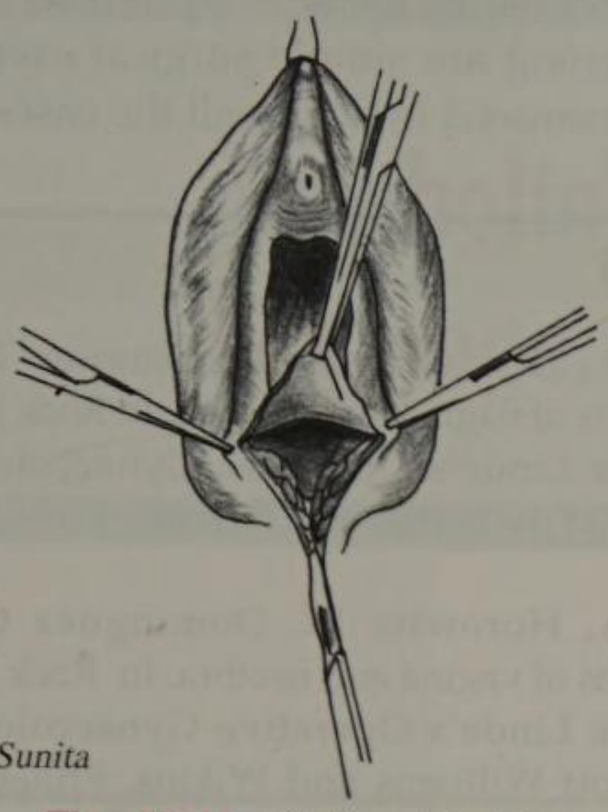

Fig. 17.15: Perineal incision

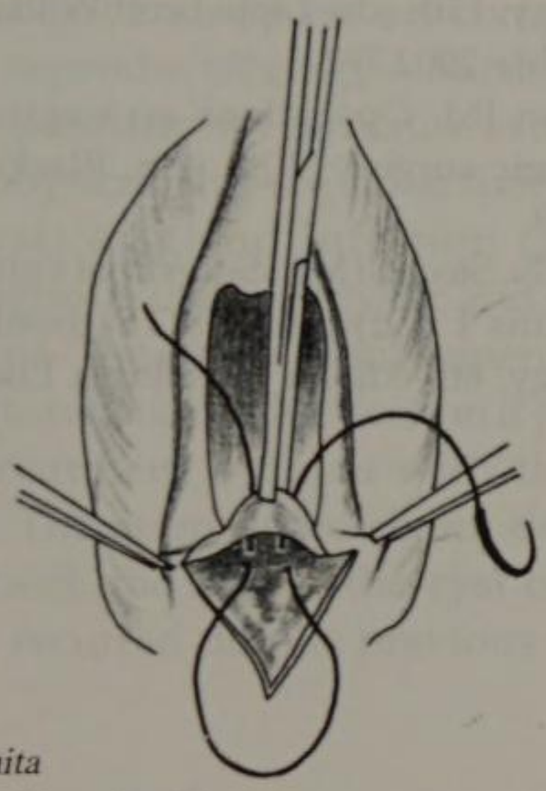

Fig. 17.16: Fixation of flap

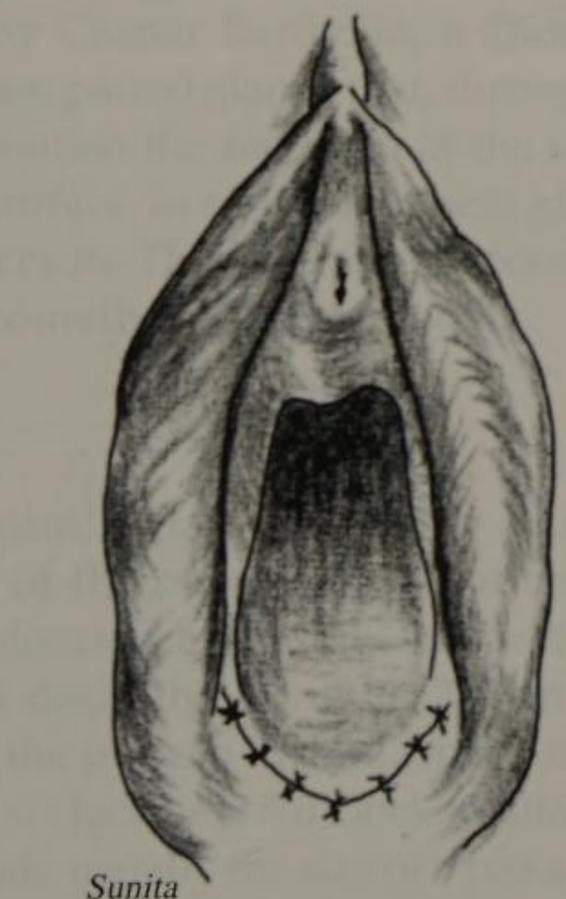

Fig. 17.17: Completion of the procedure

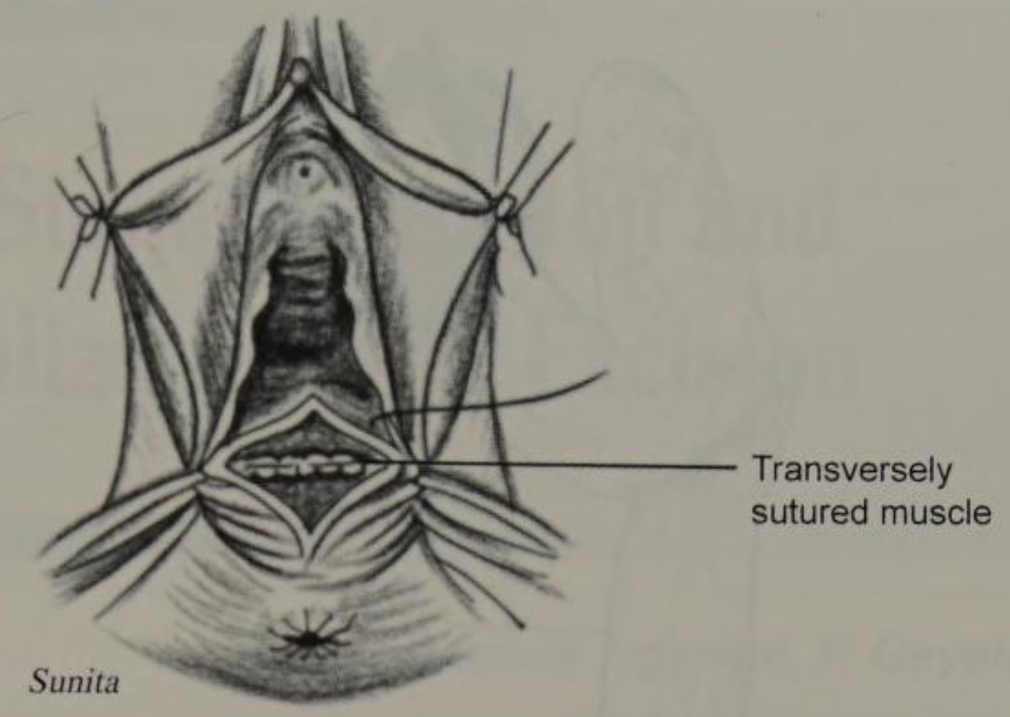

Fig. 17.18: Short median episiotomy being sutured transversely

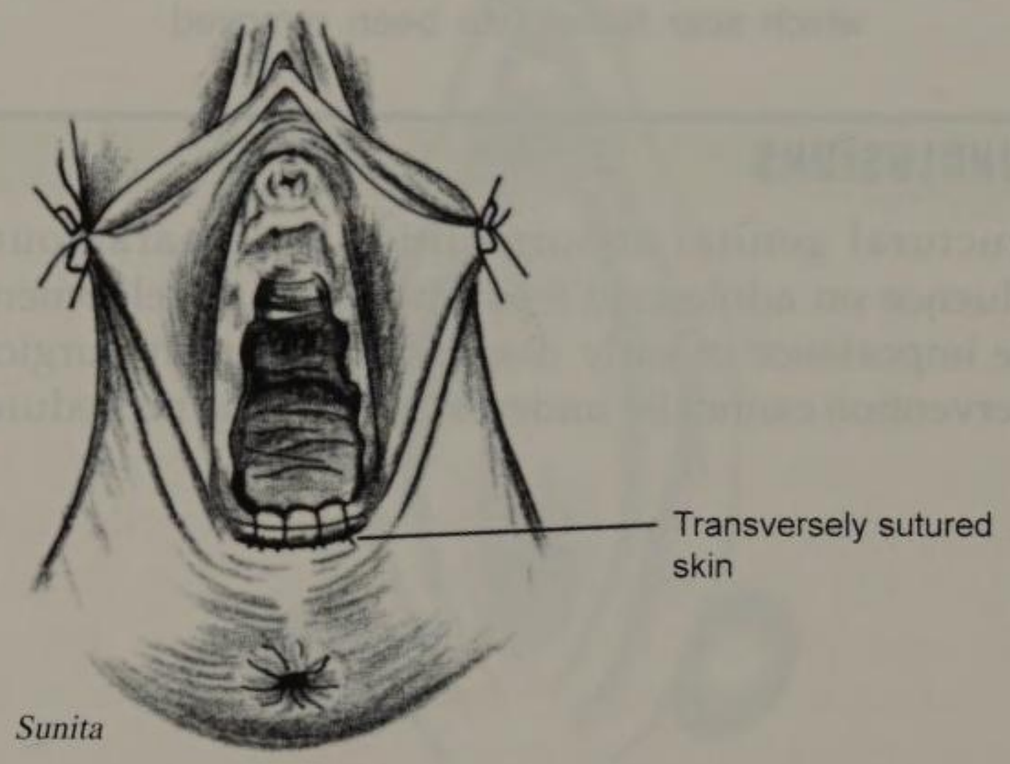

Fig. 17.19: Completion of the procedure of short median episiotomy

closer and stitched horizontally. Subsequently skin edges are also sewn horizontally (Figs 17.18 to 17.19).

Complex Postepisiotomy Vestibular Scarring

It requires excision down to healthy tissue because if it is left to granulate, risk of shrinkage is present. Under these circumstances a small posteriorly placed pedicled flap may be utilized (Fig. 17.20).[5]

Postoperative Care

1. Scrupulous local cleanliness is essential.
2. Encourage patient to engage in intercourse as soon as the wound is healed.
3. Operative site should be inspected after seven days to remove any retained sutures.

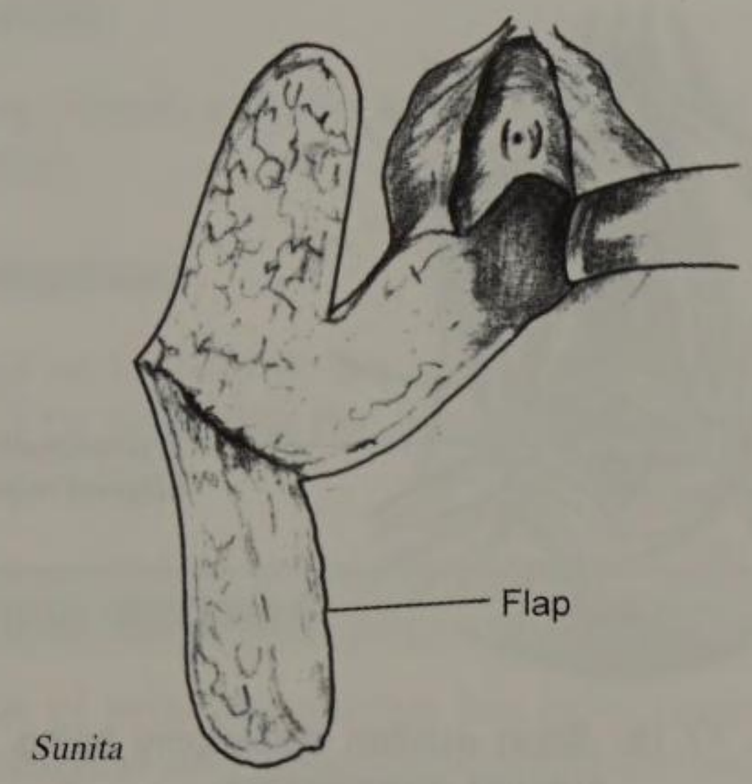

Fig. 17.20: Transposition flap to cover the area from which scar tissue has been removed

CONCLUSIONS

Structural genital abnormalities have paramount influence on adolescent's psychosexual development. The importance of early diagnosis and timely surgical intervention cannot be underestimated. The procedures described above like hymenectomy, labial fusion release, introital widening are simple surgical exercises where success is guaranteed in nearly all the cases.

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18 Bartholin's Gland Surgery: Incision and Drainage, Marsupialization and Excision

Rachna Agarwal, R Gayathri

INTRODUCTION

Bartholin gland cyst and abscess are common problems in women of reproductive age.[1] Bartholin cysts are generally asymptomatic but can cause extreme pain and limitation of physical and sexual activity due to duct dilatation (cyst) or gland infection (abscess). The differential diagnosis includes cystic and solid lesion of vulva and vagina. The goal of management is to preserve the gland and its function of lubrication if possible. There are various treatment options with their potential complications. The appropriate choice depends on the age of the patient, the size of the cyst or abscess and whether it has recurred despite previous treatment.

Background

Bartholin glands (greater vestibular glands) were first described by Caspar Bartholin, a Dutch anatomist, in 1677. They are paired glands that, through their secretion of fluid, maintain the moisture of the vaginal mucosa's vestibular surface. In rare cases, these glands form either abscesses or cysts. They are homogenous to the Cowper's gland (bulbourethral gland) in males.

Anatomy

The Bartholin's glands develop from buds in the epithelium of the posterior area of the vestibule. The glands are located bilaterally at the base of the labia minora and drain through 2 to 2.5 cm long ducts that empty into the postero-lateral aspect of the vestibule at about the 4 o'clock and 8 o'clock positions[2,3] (Fig. 18.1). The glands are usually the size of a pea and rarely exceed 1 cm. They are not palpable except if the duct become cystic or a gland abscess develops.

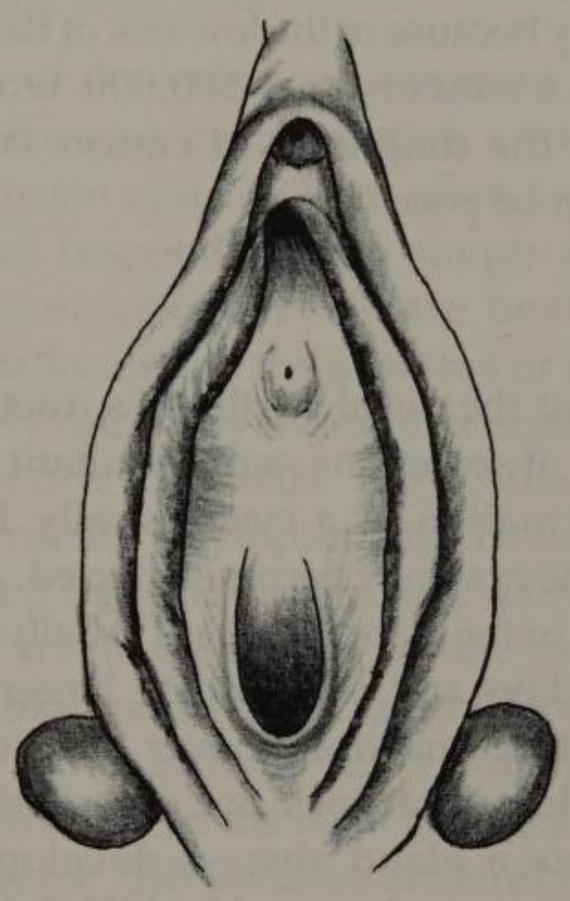

Fig. 18.1: Diagrammatic representation of situation of Bartholin glands in relation to labia majora

The glands are composed of cuboidal epithelium and ducts are mostly of transitional epithelium. The ducts exist just external to the hymenal ring into a fold between the hymen and the labium where the duct lining becomes squamous epithelium. Therefore, either squamous carcinoma or adenocarcinomas can develop in a Bartholin gland. The glands secretion provides some moisture for the vulva but not needed for sexual lubrication; thus removal of a Bartholin gland does not seem to compromise the vestibular epithelium or sexual function.

Epidemiology

Bartholin's duct cysts, the most common cystic masses in the vulva, occur in the labia majora.[4,5] Two percent of

women develop a Bartholin's duct cyst or gland abscess at sometime in life.[1] Abscesses are almost three times more common than cysts.

Gradual involution of the Bartholin's glands can occur by the time a woman reaches 30 years of age.[6] This may account for the more frequent occurrence of Bartholin's duct cysts and gland abscesses during the reproductive years, especially between 20 and 29 years of age.

Because the Bartholin's glands usually shrink during menopause, a vulvar growth in a postmenopausal woman should be evaluated for malignancy, especially if the mass is irregular, nodular, and persistently indurated.[7] Hence, excisional biopsy may be required. Some investigators have suggested that surgical excision is unnecessary because of the low risk of Bartholin's gland cancer (0.114 cancers per 100,000 woman-years).[8] However, if the diagnosis of cancer is delayed, the prognosis can be poor.

Pathology

Obstruction of the distal Bartholin's duct may result in the retention of secretions, with resultant dilation of the duct and formation of a cyst, usually 1-3 cm in size (Fig. 18.2). The cyst may become infected, and an abscess may develop in the gland. Abscess usually develops over two to four days and can become larger than 8 cm. It tends to rupture and drains over four to five days. A Bartholin's duct cyst does not necessarily have to be present before a gland abscess develops. Bartholin's gland abscesses are polymicrobial.[4,9,10] (Table 18.1). Brook has reported 67 different bacterial isolates similar to natural vaginal flora in a series of Bartholin gland abscess.[11] Although *Neisseria gonorrhoeae* is the predominant aerobic isolate, anaerobes are the most common pathogens.[9,11] Chlamydia trachomatis also may be a causative organism.[9,11] However, Bartholin's duct cysts and gland abscesses are no longer considered to be exclusively the result of sexually transmitted infections.[4] Vulvovaginal surgery is an uncommon cause of these cysts and abscesses.[12]

Table 18.1: Isolates from Bartholin's gland abscesses[4,9,10]

Aerobic organisms	*Anaerobic organisms*
Neisseria gonorrhoeae	*Bacteroides fragilis*
Staphylococcus aureus	*Clostridium perfringens*
Streptococcus faecalis	*Peptostreptococcus species*
Escherichia coli	*Fusobacterium species*
Pseudomonas aeruginosa	
Chlamydia trachomatis	

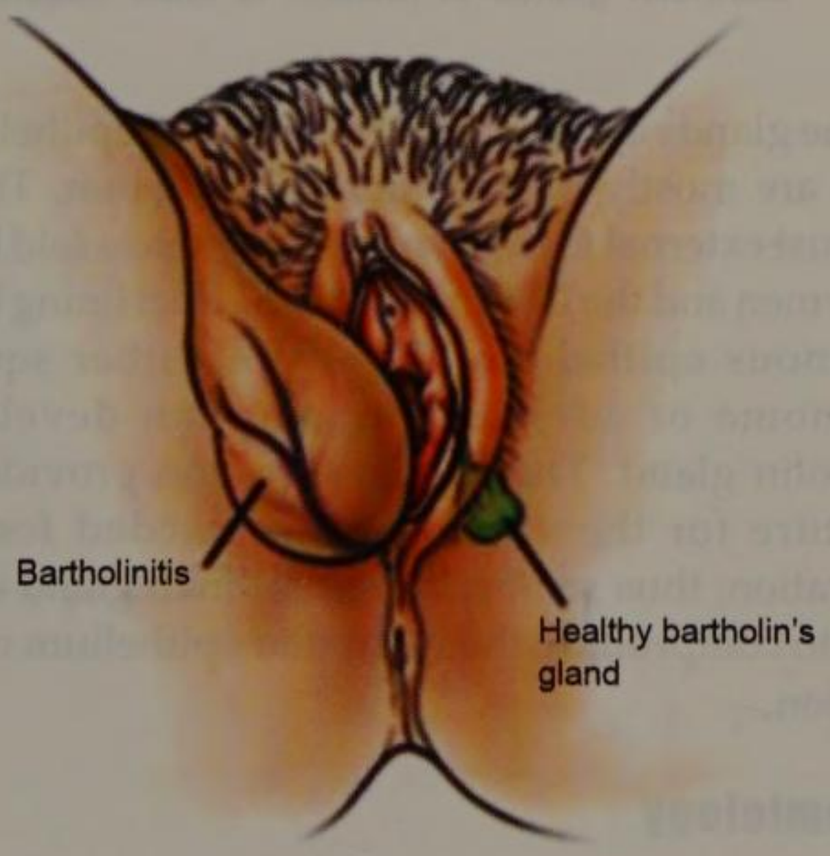

Fig. 18.2: Right distal Bartholin duct dilatation and infection; Bartholinitis

History

Bartholin cysts are usually asymptomatic. However, if symptomatic may present as painful unilateral labial edema, difficulty in walking, sitting, sexual intercourse, and dyspareunia. In Bartholin gland abscess the symptoms are exacerbated and may be so painful that the patient is incapacitated. The sudden relief of pain followed by discharge is highly suggestive of spontaneous rupture.

Physical Examination

Diagnosis of a Bartholin cyst or abscess is made primarily on physical examination findings. A cyst may be seen during a routine gynaecologic examination (Fig. 18.3). In abscess, a labial mass may be present which may be very tender and fluctuant and may be associated with vulval edema (Figs 18.4 and 18.5). Fever occurs in approximately one-third of patients. Spontaneous rupture may occur. If spontaneously ruptured, the mass decompresses and may yield few findings other than discharge, which may be purulent if an abscess had formed.

Laboratory Studies

1. Blood tests are not necessary to evaluate an uncomplicated abscess or cyst.

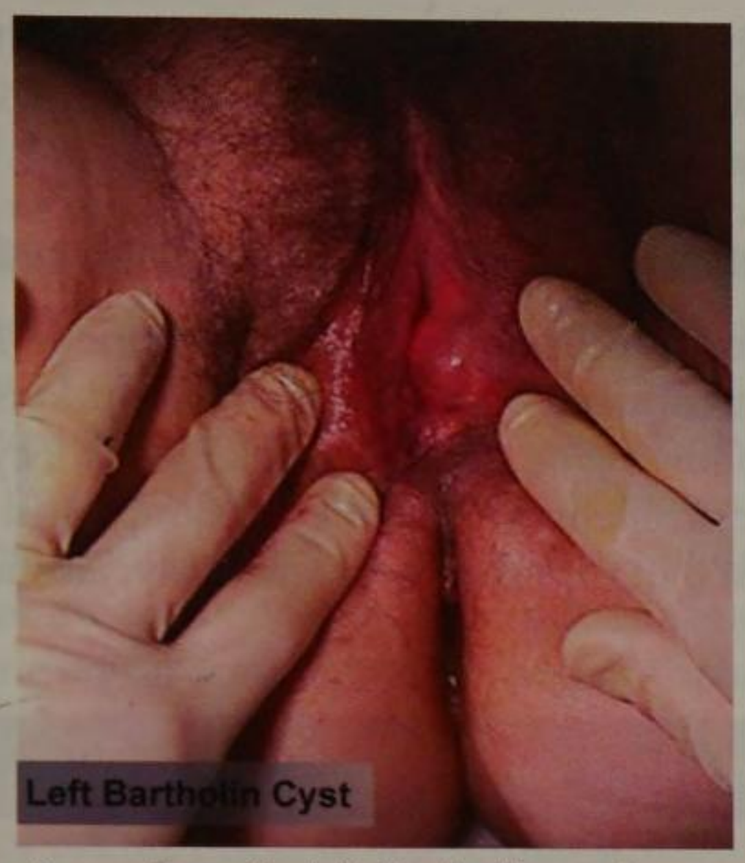

Fig. 18.3: Asymptomatic left Bartholin cyst as seen on routine gynaecological examination

Fig. 18.4: Right Bartholin abscess; fluctuant and tender

Fig. 18.5: Right Bartholin abscess; fluctuant, tender with vulval edema

2. Consider syphilis serology because abscesses may be caused by sexually transmitted organisms.
3. Cultures are rarely useful in treatment of abscess; furthermore, routine culturing of drained fluid is not recommended.
4. Test fluid or cervical specimens for *N. gonorrhoeae* and *Chlamydia* species if definitive identification of these organisms is desired for social or epidemiologic reasons.

Differential Diagnosis (Table 18.2)[12]

A number of vulvar and vaginal lesions can mimic Bartholin gland cysts or abscesses and should be included in the differential diagnosis.

Sebaceous cysts of the vulva are common and present similarly to sebaceous cysts in other areas. These are epidermal inclusion cysts and are often asymptomatic. If infected, they respond well to simple incision and drainage. *Dysontogenetic cysts* are benign mucus-containing cysts located in the introitus or labia minora and are probably caused by incomplete separation of the cloaca from the urorectal folds. They contain rectal-like tissue and are usually asymptomatic. *Hematomas* of the vulva are caused by straddle injuries, sporting injuries, abuse or other trauma. *Fibromas* are the most common benign solid tumors of the vulva. Indications for excision include pain, rapid growth and cosmetic concerns. *Lipomas* can also occur on the labia majora and can grow to an enormous size. *Hidradenomas* are rare benign tumors that arise on either the labia majora or, less commonly, the labia minora. They should be biopsied if they bleed

Table 18.2: Differential diagnosis of Bartholin gland abnormalities[12]

Vulvar lesions	*Vaginal lesions*
Sebaceous cyst	Vaginal inclusion cyst
Dysontogenetic cyst	Endometriosis
Hematoma	Adenosis
Fibroma	Gartner duct cyst
Lipoma	Leiomyoma
Hidradenoma	Inguinal hernia
Syringoma	
Endometriosis	
Myoblastoma	
Accessory breast tissue	
Leiomyoma	
Von Recklinghausen's tumor	
Adenocarcinoma	

or removed if they are symptomatic. Other rare vulvar masses include syringomas, vulvar endometriosis, granular cell myoblastomas, accessory breast tissue, leiomyomas and neural sheath tumors of von Recklinghausen's disease (neurofibromatosis).

Cystic lesions can also occur in the vagina and are usually distinguished from Bartholin gland cysts by their anatomic location. In some cases, however, diagnosis can be difficult. Vaginal lesions include inclusion cysts, endometriosis, adenosis and Gartner duct cysts (benign cysts of mesonephric origin usually located on the anterolateral vaginal wall). Various vulvar lesions and their characteristics are shown in Table 18.3.[1,6,7]

Management of Bartholin Gland Cyst and Abscess

Asymptomatic Bartholin gland cyst under 40 may not require treatment. Various treatment options described in the following section are available for a cyst causing cosmetic problems or bothersome symptoms. If a patient has a cyst that ruptured spontaneously, all she needs is a

Table 18.3: Differential diagnosis of cystic and solid vulvar lesions[1,6,7]

Lesion	*Location*	*Characteristics*
Cystic lesions		
Bartholin's duct cyst	Vestibule	Usually unilateral; asymptomatic if remains small
Epidermal inclusion cyst	Labia majora (usually)	Benign, mobile, nontender; caused by trauma or obstruction of pilosebaceous ducts
Mucous cyst of the vestibule	Labia minora, vestibule, periclitoral area	Soft, less than 2 cm in diameter, smooth surface, superficial location; solitary or multiple; usually asymptomatic
Hidradenoma papilliferum	Between labia majora and labia minora	Benign, slow-growing, small nodule (2 mm to 3 cm); arises from apocrine sweat glands
Cyst of the canal of Nuck	Labia majora, mons pubis	Soft, compressible; peritoneum entrapped within round ligament; may mimic inguinal hernia
Skene's duct cyst	Adjacent to urethral meatus in vestibule	Benign, asymptomatic; if large, may cause urethral obstruction and urinary retention
Solid lesions		
Fibroma	Labia majora, perineal body, introitus	Firm, asymptomatic; may develop pedicle; may undergo myxomatous degeneration; potential for malignancy
Lipoma	Labia majora, clitoris	Benign, slow-growing; sessile or pedunculated
Leiomyoma	Labia majora	Rare; solitary, firm; arises from smooth muscle
Acrochordon	Labia majora	Benign, fleshy, variable size; usually pedunculated but may be sessile; polypoid in appearance
Neurofibroma	Multicentric	Small, fleshy; polypoid in appearance; multiple; associated with von Recklinghausen's disease
Angiokeratoma	Multicentric	Rare, benign; vascular; variable size and shape; single or multiple; associated with and aggravated by pregnancy; associated with Fabry's disease
Squamous cell carcinoma	Multicentric	Related to benign epithelial disease in older women and to human papillomavirus infection in young women

hot sitz bath (Fig. 18.5). Occasionally use of broad spectrum antibiotics is indicated if secondary infection develops.

Treatment options for abscess are similar to that of symptomatic cysts. If an abscess points and ruptures spontaneously, the patient may need only sitz bath, antibiotics and pain medication.

Definitive treatment includes drainage of cavity and preventing premature closure in cases of abscess. Patient comfort is of utmost importance for successful drainage. This requires the use of adequate anaesthesia essentially when incising any abscess. Attempts without anaesthesia will result in an uncooperative patient, reducing the likelihood of successful drainage. Either topical anaesthetics are applied to the mucosa followed by submucosal injection of local anaesthetic (the minimum pain control required), or conscious sedation is given. In patients with large or complex abscesses or complicated procedures, general anaesthesia in the operating room may be required.

Surgical Techniques for Treatment of Cyst/Abscess

Needle Aspiration

This technique differentiates an abscess from a cyst. One study, by Cheetham,[9] suggests that aspiration alone is adequate treatment for cyst or abscess (85% cure rate). Antibiotics are given when purulent fluid is recovered. This approach is contrary to commonly accepted principles of abscess care (i.e., incision and drainage). Omale[13], on the contrary found that most cysts/abscesses recur if treated only by aspiration.

Incision and Drainage

Although incision and drainage is a relatively quick and easy procedure that provides almost immediate relief to the patient, this approach should be discouraged because there is a tendency for the cyst or abscess to recur.[12,15] One investigator reported a 13% failure rate for the procedure.[16] Furthermore, incision and drainage may make later Word catheter placement or marsupialization difficult. Moreover, it is a very painful procedure and requires multiple packing changes. Hence, definitive drainage involves Word catheter placement for Bartholin's duct cysts and gland abscesses, and marsupialization for duct cysts.

WORD Catheter Placement

1. It is commonly used to treat Bartholin's duct cyst or gland abscess.[10]
2. First described in 1952, the technique was modified by Word in 1964.
3. Technique involves place a small catheter in the abscess cavity through a stab incision in mucosa (Fig. 18.6).
4. This allows for drainage and epithelialisation of surgically created tract when left in place for 4-6 weeks.
5. Simplicity is the technique's main advantage. Patients tolerate presence of catheter and allows restoration of gland function.

The stem of this rubber catheter is 1 inch long and the diameter that of a No. 10 French Foley catheter. The small, inflatable balloon tip of the Word catheter can hold about 3 ml of saline (Fig. 18.6).

After sterile preparation and the administration of a local anaesthetic, the wall of the cyst or abscess is grasped with a small forceps, and a No. 11 blade is used to make a 5 mm (stab) incision into the cyst or abscess (Fig. 18.7).[2,15] It is important to grasp the cyst wall before the incision is made; otherwise the cyst can collapse, and a false tract may be created. The incision should be within the introitus external to the hymenal ring in the area of the duct orifice. If the incision is too large, the Word catheter will slip out. After the incision is made, the Word catheter is inserted, and the balloon tip is inflated with 2

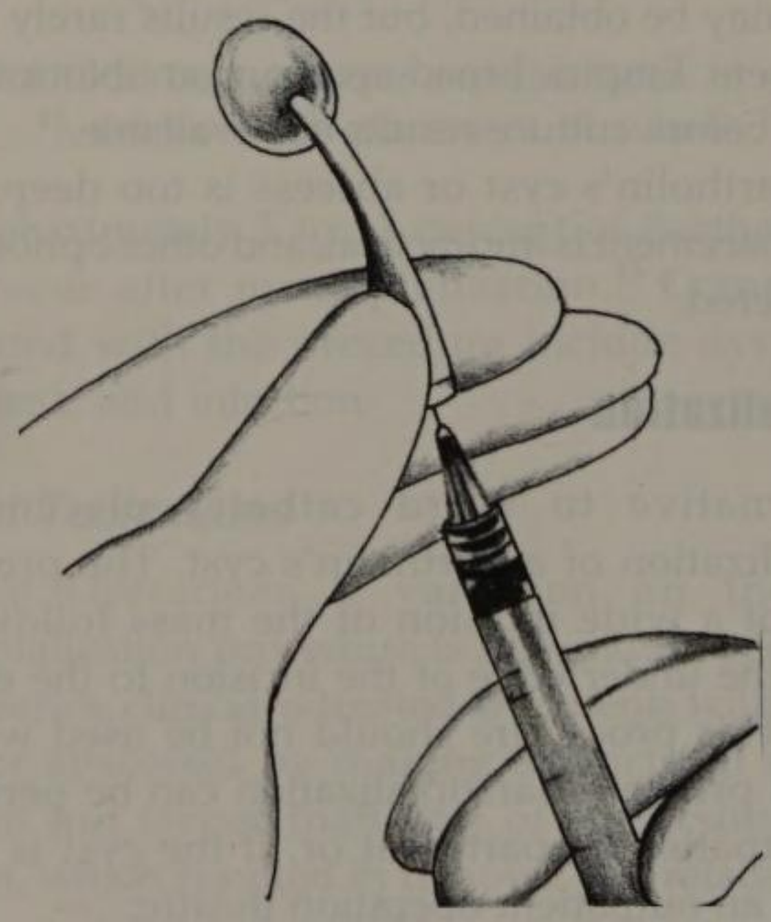

Fig. 18.6: The word catheter

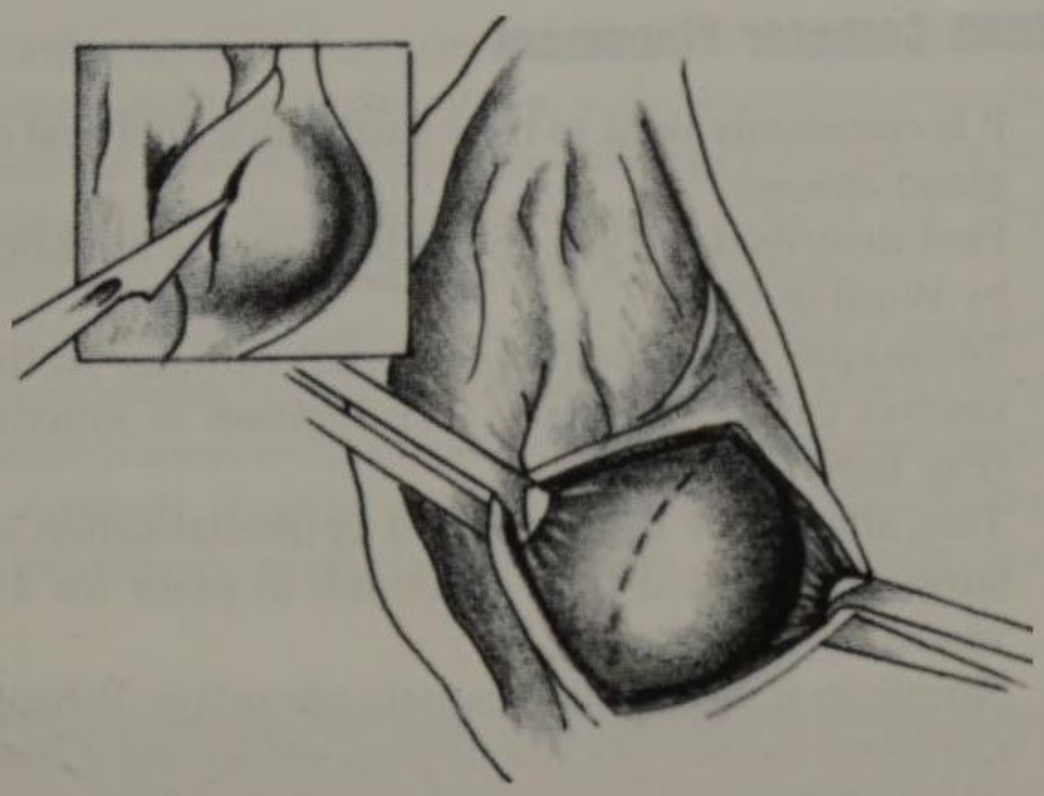

Fig. 18.7: Medial stab incision of Bartholin gland cyst, before placement of word catheter

to 3 ml of saline solution injected through the hub of the catheter (Fig. 18.8). The inflated balloon allows the catheter to remain within the cavity of the cyst or abscess (see Fig. 18.6). The free end of the catheter can be placed in the vagina.[15] To allow epithelialization of the surgically created tract, the Word catheter is left in place for four to six weeks, although epithelialization may occur by three to four weeks.

Sitz baths taken two to three times daily may aid patient comfort and healing during the immediate postoperative period. Coitus may be resumed after catheter insertion. Unless there is evidence of cellulitis, antibiotic therapy is unnecessary. If cellulitis is present, cultures may be obtained, but the results rarely change management. Empiric broad-spectrum antibiotic therapy is started before culture results are available.[11]

If a Bartholin's cyst or abscess is too deep, Word catheter placement is impractical, and other options must be considered.[7]

Marsupialization

An alternative to Word catheter placement is marsupialization of a Bartholin's cyst. The procedure consists of a wide incision of the mass followed by suturing the under edge of the incision to the external mucosa. This procedure should not be used when an abscess is present. Marsupialization can be performed in the outpatient department or, if the cyst is deeply seated, in an outpatient operation theatre.

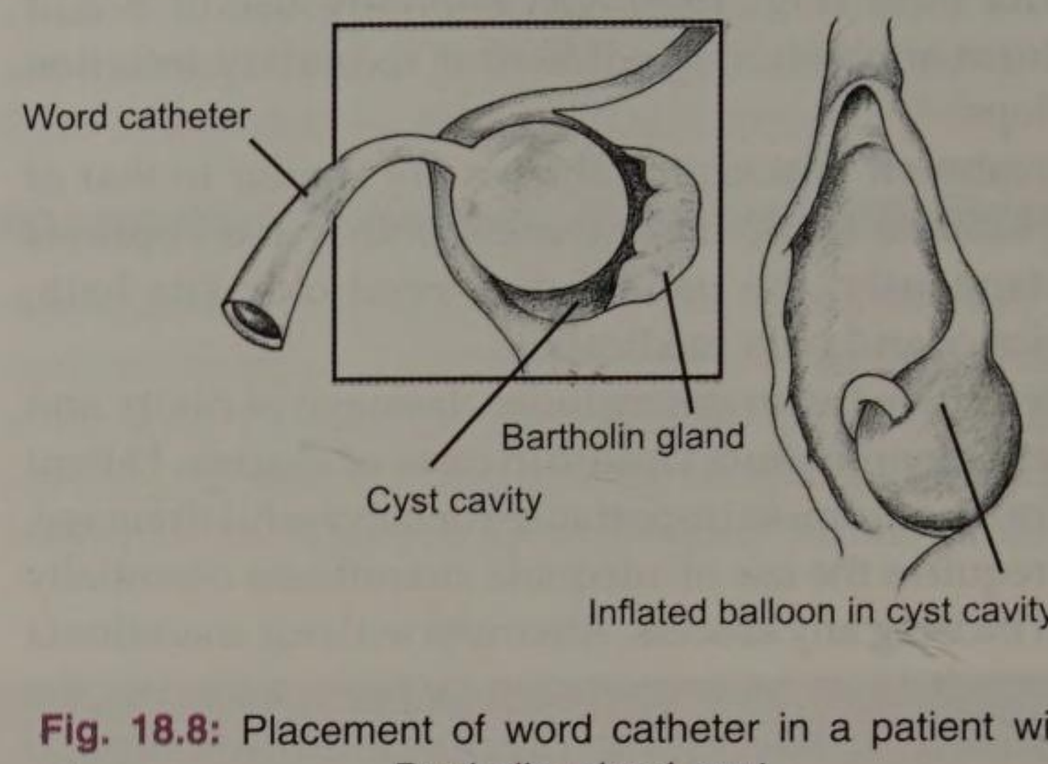

Fig. 18.8: Placement of word catheter in a patient with a Bartholin gland cyst

After sterile preparation and the administration of a local anaesthetic, the cyst wall is grasped with two small haemostats.[2,15] A vertical incision is made in the vestibule over the centre of the cyst and outside the hymenal ring.[17] The incision should be about 1.5 to 3 cm long, depending on the size of the cyst (Fig. 18.9).

After the cyst is vertically excised, the cavity drains spontaneously. The cavity also may be irrigated with saline solution and, if necessary, loculations can be broken up with a haemostat. The cyst wall is then everted and approximated to the edge of the vestibular mucosa with interrupted 2-0 absorbable suture[17] (Fig. 18.10). Daily sitz baths should begin on the first postoperative day.

Fig. 18.9A: Right Bartholin cyst before marsupialization

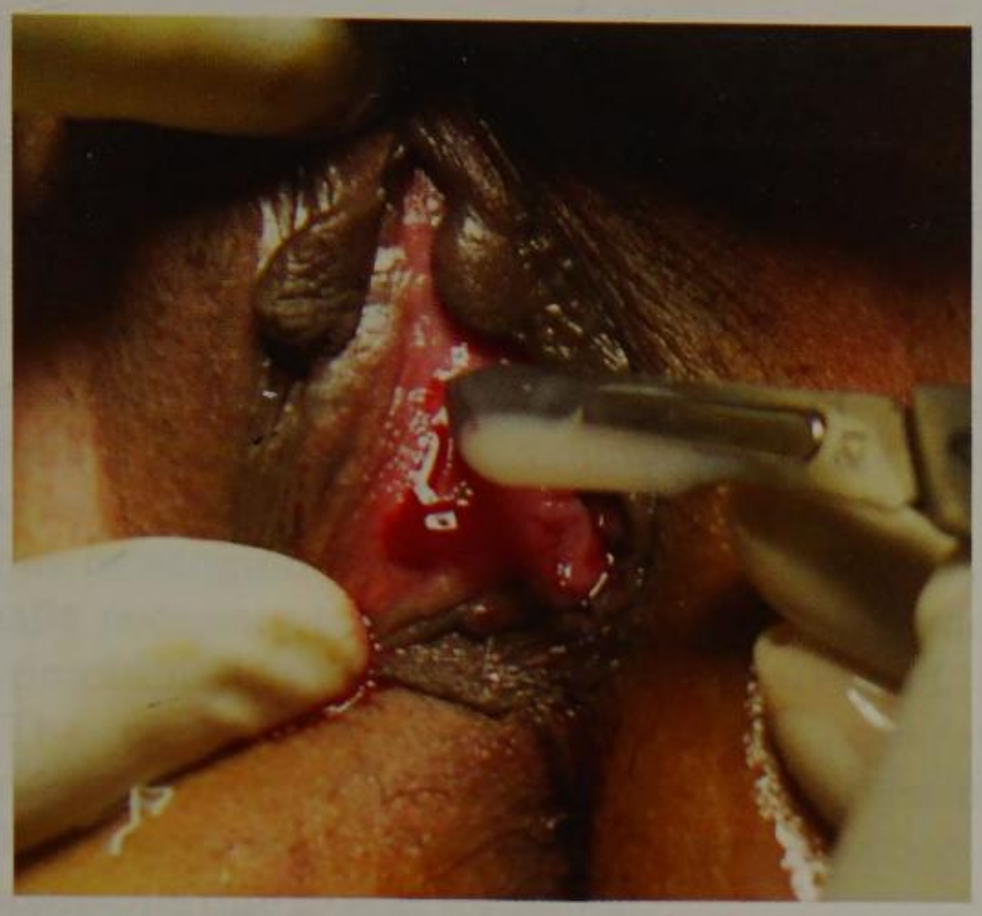

Fig. 18.9B: A vertical incision is made over the centre of the cyst to dissect it free of mucosa before marsupialization

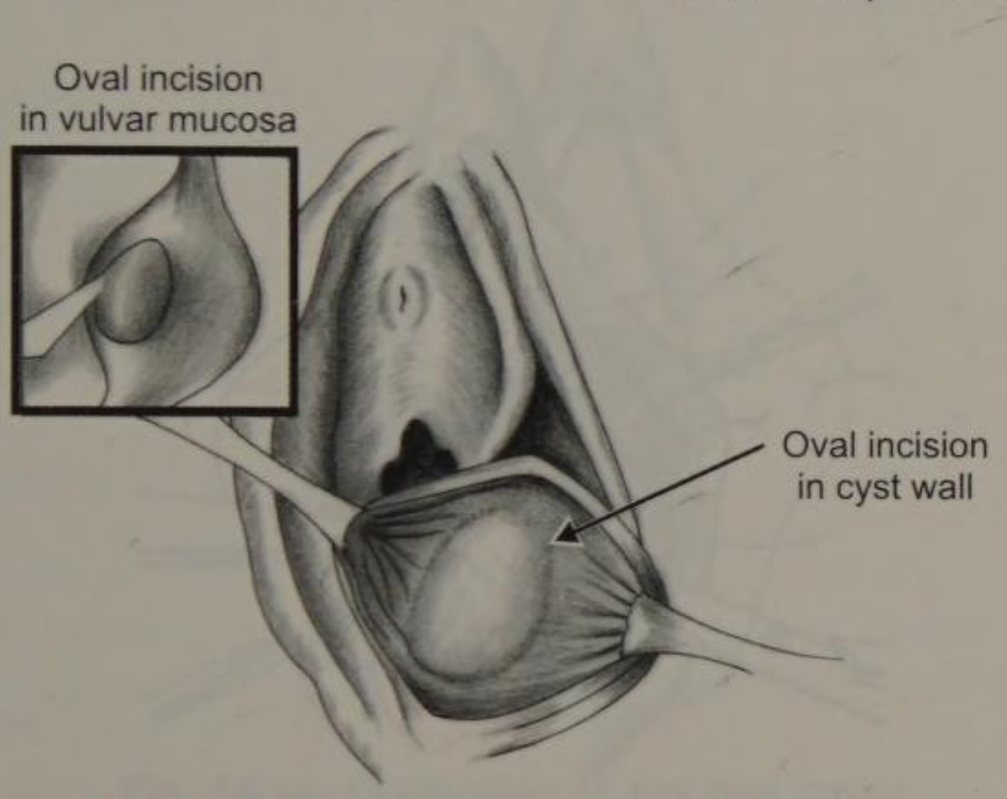

Fig. 18.9C: Diagrammatic representation of incision for marsupialization

Fig. 18.10A: The cyst wall is everted

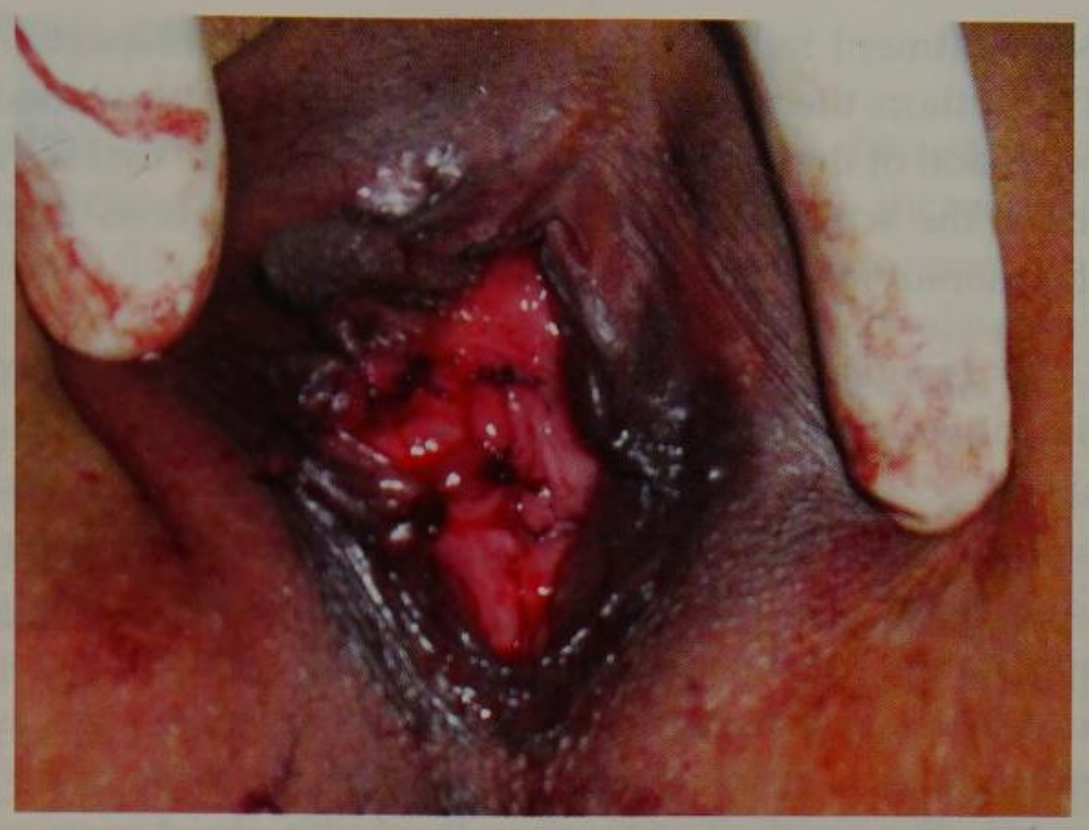

Fig. 18.10B: Edge of the cyst wall approximated to the vestibular mucosa with interrupted sutures

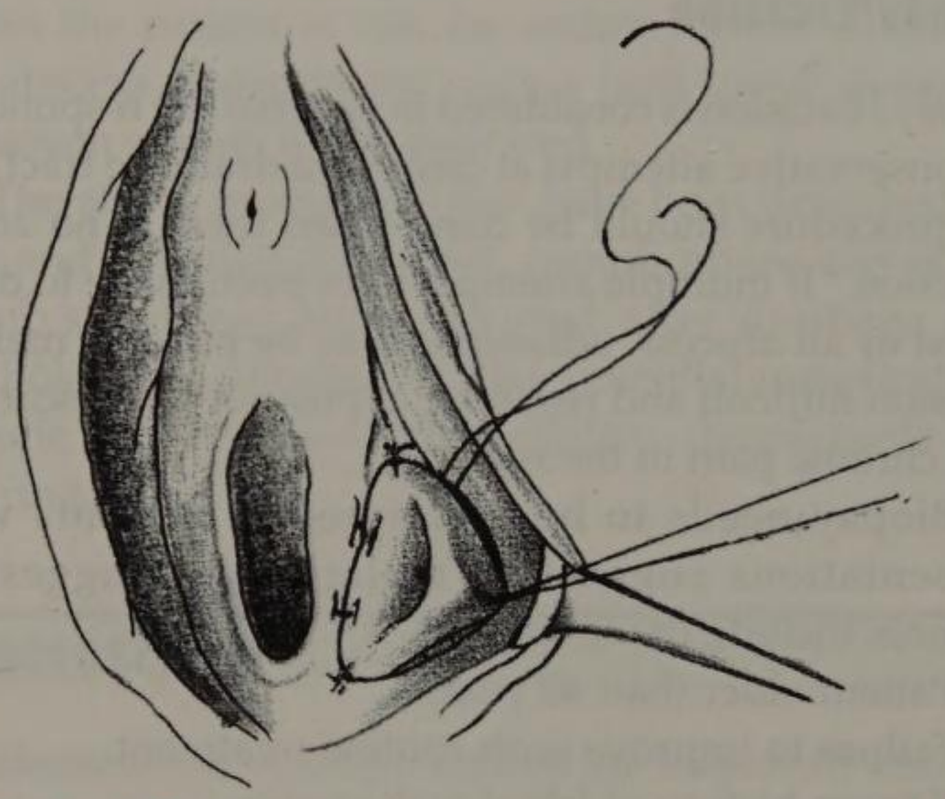

Fig. 18.10C: Diagrammatic representation of cyst wall eversion with placement of sutures

Approximately 5 to 15 percent of Bartholin's duct cysts recur after marsupialization.[18] Complications associated with the procedure include dyspareunia, hematoma, and infection.

Recent Techniques

Window Operation: A variation on the classic marsupialization procedure is a "window operation."[18] In one series, clinicians treated 47 patients with Bartholin cysts or abscesses by making an incision similar in location but larger than that of a marsupialization incision, which resulted in removal of a relatively large, oval piece of the cyst wall. The cyst wall was sewn to the skin of the vestibule using interrupted 2-0 chromic catgut in a similar fashion to the marsupialization procedure.

No treatment failures or complications were reported. The authors theorized that the larger opening prevented occlusion of the newly formed orifice, a feature that may make the window operation more advantageous than the marsupialization procedure.

Other techniques: Other techniques include incision of Bartholin gland abscess followed by curettage of the abscess cavity[19], application of silver nitrate to the cyst or abscess cavity[20,21] and use of a carbon dioxide laser. One team compared excision with silver nitrate application for the treatment of Bartholin gland abscess and cysts and concluded that silver nitrate was as effective as excision.[20] The carbon dioxide laser is also an effective method of treating Bartholin gland cysts or abscesses.[22]

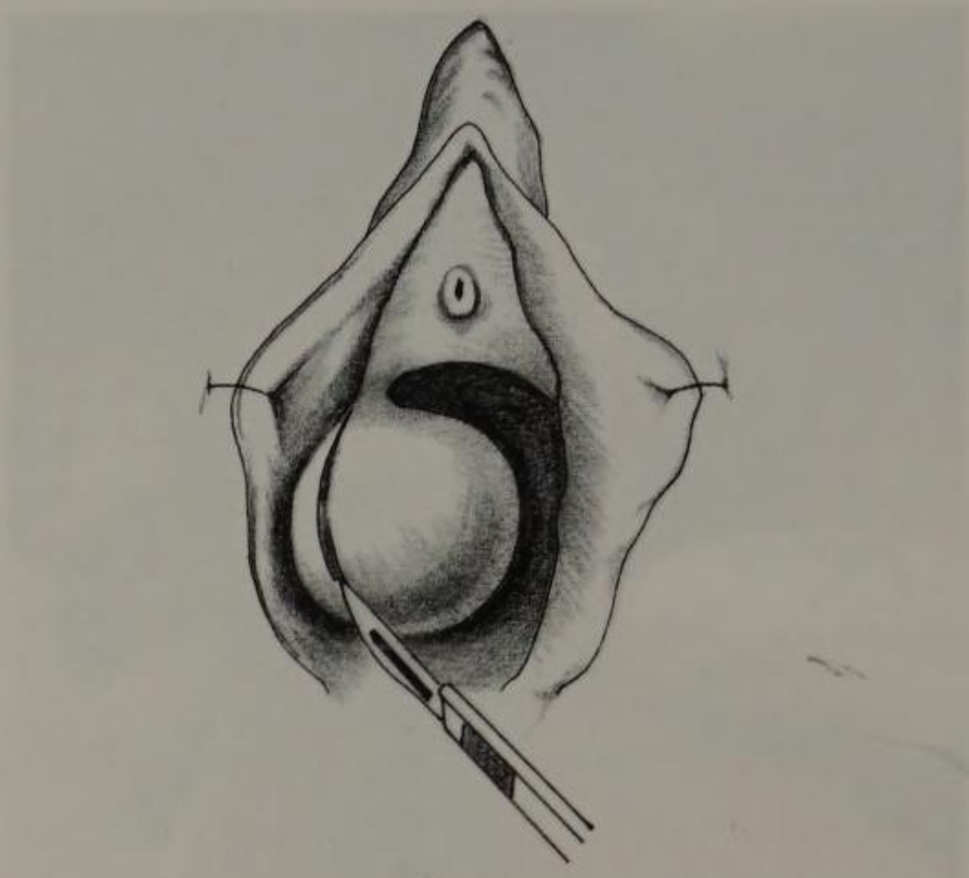

Fig. 18.11: Incising mucosa over Bartholin's cyst

Biopsy/Excision

Biopsy/Excision is considered in patients not responding to conservative attempts at creating a drainage tract, but the procedure should be done when there is no active infection.[4] If multiple attempts have been made to drain a cyst or an abscess, adhesions may be present, making excision difficult and resulting in postoperative scarring and chronic pain in the region.

Biopsy needs to be performed in patients with presentations suggesting malignancy. Suggestive features include the following:

1. Patient older than 40 years.
2. Failure to improve with routine treatment.
3. Known history of labial malignancy.
4. Chronic and/or painless mass.

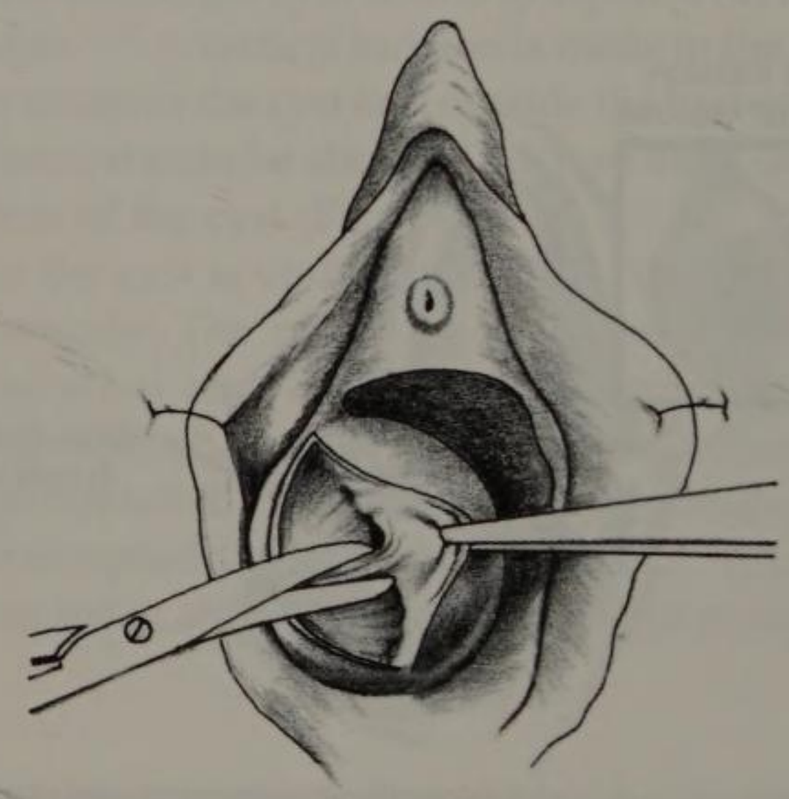

Fig. 18.12: Enucleating the cyst

Technique of Excision

Skin incision: The incision should run along the long axis of the labium majus, and be so placed that there is no risk of dyspareunia when healed. The skin will draw naturally apart, revealing the tense surface of the cyst (Fig. 18.11).

Enucleation of the cyst: The tissue plane around the cyst is now developed using a separating action of the scissors; occasional strands of fascia may need to be cut. If the gland has been involved in previous episodes of infection this dissection may not flow smoothly and more sharp dissection will be required. Tiny blood vessels will be cut and should be dealt with by fine ties or diathermy. The gland duct is resected and the entire cyst removed (Figs 18.12 and 18.13).

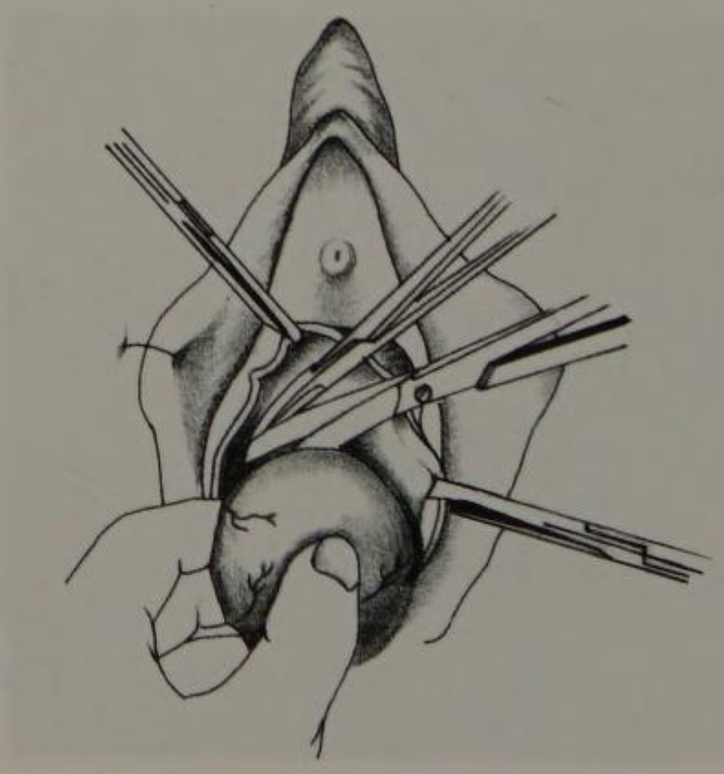

Fig. 18.13: Removal of Bartholin's cyst

Obliteration of the cavity: It is essential to completely close the cavity as venous oozing frequently occurs if a space is left, producing a hematoma which may be the nidus for infection and will significantly delay healing. Using interrupted catgut. Dexon or Vicryl sutures the cavity is obliterated; two layers will usually suffice (Fig. 18.14).

Skin closure: The cut edges of the wound are now apposed suing interrupted sutures. Continuous or subcuticular sutures are appealing but should be avoided so that any serous or sanguinous ooze can escape. A drain is not usually necessary but may be inserted and recorded if the procedure has been unusually bloody (Fig. 18.15).

The procedure can result in intraoperative hemorrhage from underlying venous plexus (vestibular bulbs), hematoma formation, secondary infection and dyspareunia due to scar formation.

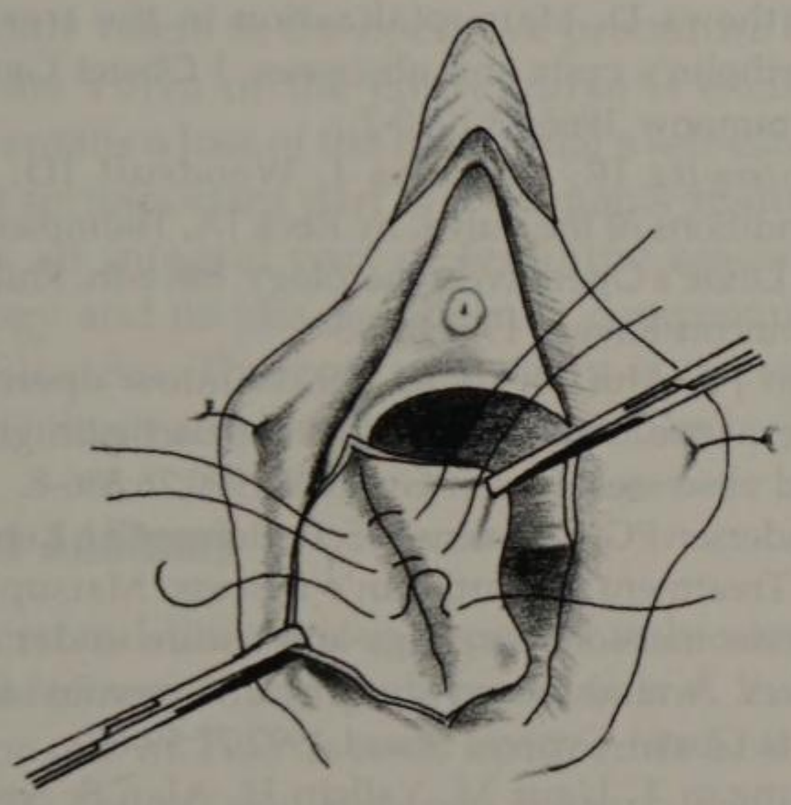

Fig. 18.14: Obliteration of the cyst cavity

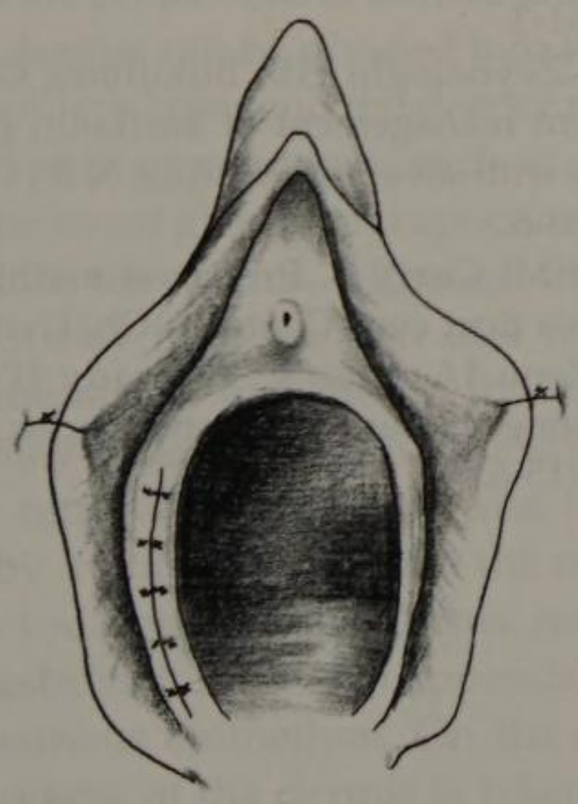

Fig. 18.15: Closure of the skin

Pregnancy

Although none of the treatment methods discussed are contraindicated in pregnant women, the increase in blood flow to the pelvic area during pregnancy may lead to excessive bleeding when Bartholin cysts or abscesses are treated. For this reason, surgical treatment for asymptomatic cysts should probably be withheld until after delivery. If treatment is necessary because a cyst becomes infected or the patient presents with an abscess, local anaesthesia is not contraindicated, and most broad-spectrum antibiotics appear safe for use during pregnancy.

Occasionally, patients present with symptomatic Bartholin gland abscesses during labour. In this situation, it seems wise to withhold treatment until after delivery if possible, since an open labial abscess theoretically places the patient at risk for endomyometritis. Unless the abscess obstructs the vagina (soft tissue dystocia), caesarean section is not indicated.

The above procedures that have been described are safe and effective. However, complications can occur, septic shock has been reported after drainage of a Bartholin gland abscess.[23] Other potential complications include excessive bleeding, cellulitis, dyspareunia and scarring.

CONCLUSIONS

Problems of the Bartholin's gland are frequently encountered in clinical practice and the key to appropriate management is a proper understanding of the anatomy and surgical techniques. While marsupialization is the main stay of treatment for uninfected cysts, this time-honoured procedure has now a new modification, the 'Window procedure.' Incision and drainage is no longer considered adequate therapy for Bartholin's abscess as the chances of recurrence are high. 'Word Catheter' placement and surgical creation of an epithelialized tract seems to be a better option in superficial cyst or abscess. Newer techniques for management of Bartholin gland abscesses include incision followed by curettage of the cavity, application of silver nitrate to the cyst or abscess cavity and use of a carbon dioxide laser. Unresponsive cysts and cysts in elderly patients should be subjected to excisional biopsy to rule out malignancy.

Key Points

1. Asymptomatic cysts under age of 40 may not require treatment.
2. Excision of all Bartholin gland cysts in patients over 40 years of age because of the possibility of cancer.[1]
3. Aspiration and incision-drainage procedure of cysts needs to be discouraged for it results in recurrence.
4. Definitive methods of treatment for cyst and abscess include placing a word catheter, marsupializing the cyst, performing a "window" procedure, application of silver nitrate to the cyst/abscess cavity, carbon dioxide laser excision and surgical excision of the entire cyst.
5. While it remains important to test for gonococcal and chlamydial infection, the polymicrobial nature of these abscesses require broad spectrum antibiotic and drainage.

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19

Simple Vulvectomy for Intraepithelial Neoplasia

Amita Suneja, Richa Agarwal

INTRODUCTION

Vulvectomy refers to the operative procedure in which part of the vulva or the entire vulva is excised. The surgery entails a loss of the individual's self-esteem as it destroys an important part of a woman's anatomy. The vulva is an integral part of feminine sexuality and physiology and its loss significantly compromises day-to-day function. The goal of surgery is to remove all disease without any loss of sexual function.[1]

Surgical Anatomy

To understand the various types of vulvectomy, it is important to review various layers of vulva[2]. Vulvar skin is composed of two layers, epidermis and dermis (Fig. 19.1). The margin between epidermis and dermis is an irregular one because of the rete ridges. Between the rete ridges are projections of dermis known as dermal papillae. The dermis can be divided into two layers, the superficial papillary layer and the deeper reticular layer. There are also skin appendages, such as pilosebaceous follicles, eccrine sweat glands, and apocrine glands which project deep into the dermis. Although the thickness of the epidermis may be a fraction of a millimeter, the dermis may measure 7 to 8 mm in thickness, and skin appendages may penetrate the full thickness. When the epidermis is removed, the donor site heals without replacement by a skin graft because the remaining skin appendages located in the dermis have not been completely destroyed. Each skin appendage serves as a source of squamous epithelium. On the other hand, if the entire thickness of the dermis is taken and the skin appendages are completely destroyed, the operative site must be grafted or closed.

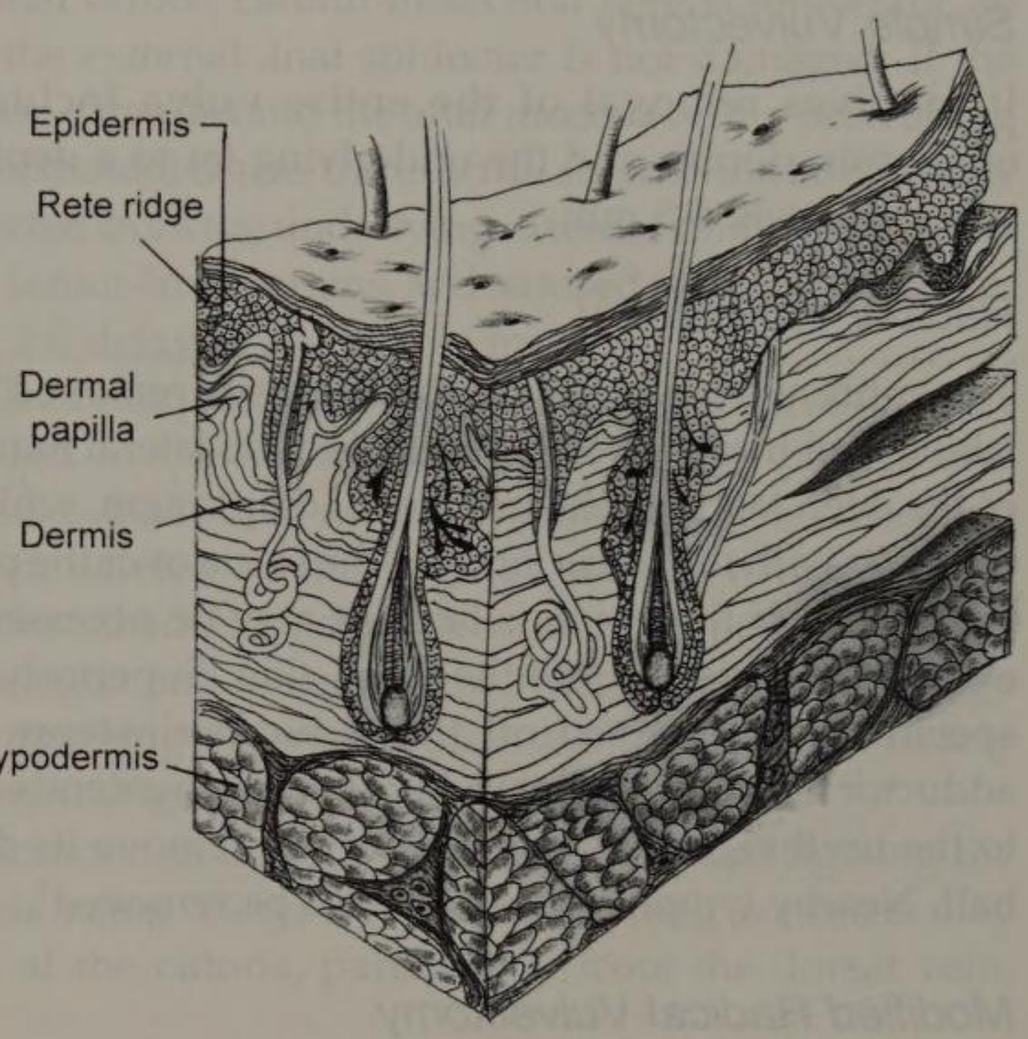

Fig. 19.1: Schematic diagram showing the microscopic cut section of the vulvar skin. Vulvar skin is composed of epidermis, dermis plus the skin appendages

Reid has suggested that four surgical planes can be recognized.[3] The first surgical plane represents the epidermis down to the basement membrane. The second surgical plane extends into the papillary layer of the dermis. The third surgical plane reaches well into the reticular dermis and uncovers the coarse collagens bundles that can be seen through the colposcope as grayish white fibres. The fourth surgical plane involves complete removal of the skin right down to the underlying subdermal fat. If this level is reached, healing must take place from the periphery, or a graft must be supplied.

Types of Vulvectomy

Type of vulvectomy depends upon the depth of tissue removed.

Skinning Vulvectomy

It entails removal of the epidermis and the underlying dermis and preserves the subcutaneous tissue of the vulva with or without replacement by a skin graft. This procedure preserves the contours of the vulva, which are derived from the underlying subcutaneous fat and fascia and hence, gives an optimal cosmetic and functional result. It is used for the treatment of extensive or multifocal vulvar *in situ* disease.

Simple Vulvectomy

It involves removal of the entire vulva including epidermis, dermis and the underlying fat to a depth of approximately 4-5 mm.

Radical Vulvectomy

The entire vulva, including the clitoris is removed. The labiocrural incisions are extended to the lateral margins of the deep fascia of the urogenital diaphragm, which is coplanar with the fascia lata and the fascia over the pubic symphysis. If the lesion is large, it may be necessary to extend the incision onto the thigh skin. Superiorly, the specimen is dissected off the pubic periosteum and adductor fascia. In patients where the lesion extends close to the urethra, it may be necessary to remove its distal half. Nearby lymph nodes may also be removed[4].

Modified Radical Vulvectomy

It refers to radical removal of the portion of the vulva containing the tumor. Recommendations have included 1 to 3 cm skin margins in the treatment of well localized, unifocal lesions, although most authors recommend a 2 cm margin.

If these procedures are used to remove a large area of skin from the vulva, skin grafts from other parts of the body may be needed to cover the wound. However, the surgical wounds resulting from these procedures can usually be closed without grafts and provide a very satisfactory appearance.

Simple Vulvectomy

Indications

1. Extensive Paget's disease.[5]
2. Widespread Vaginal Intraepithelial Neoplasia (VIN) where it is difficult to rule out invasive cancer, even with multiple biopsies. Some surgeons use the CO_2 laser to vaporize multifocal lesions, but this method does not provide a specimen for histologic review. Therefore, most authorities recommend the restriction of the CO_2 laser to physicians experienced in vulvar disease to avoid vaporizing unrecognized invasive carcinoma.[6]
3. VIN in elderly women: The risk of invasive cancer is greater in the older patient and the desire for cosmetic results is less, so the use of surgical excision is favoured.
4. The procedure may be used for widespread recurrent vulvar intraepithelial neoplasia following previous treatments or granulomatous diseases, which do not respond to medical therapy or wide local excision.[7]
5. Elephantiasis of vulva not responding to medical therapy.[8]
6. Local benign lesions demanding wide excision e.g. lymphangiectasias of vulva.[9]
7. Verrucous carcinoma: Wide local excision or hemivulvectomy is the adequate treatment but simple vulvectomy may be offered in cancerophobic patient (Fig. 19.2).

Preoperative Preparation

In postmenopausal women, it is helpful to give estrogen replacement therapy for a week before surgery, provided there is no contraindication. This will improve tissues of the lower genital tract, making dissection and tissue handling easier and improving healing. Bowel prepara-

Fig. 19.2: The verrucous carcinoma involving the left labia minora and labia majora

tion enables potential damage to the rectum or anus at surgery, to be repaired more safely, and by delaying the return of bowel movement after surgery, allows healing of anal sphincter if it has been repaired.[10]

Operative Procedure

General, epidural, or spinal anesthesia can be administered and the patient placed in the lithotomy position. After preparation, the urethral catheter is passed and the excision margins are marked with a surgical marking pen after application of 5% acetic acid to demonstrate areas and borders of neoplastic or viral involvement. In planning the incision, it is best to leave as much skin of the vestibule surrounding the urethra as possible (usually 1 cm) to facilitate closure and avoid distortion of the meatus. The initial incision should be made at the vaginal outlet so that the urethral borders can be well demarcated and the vaginal epithelium undermined for a short distance. If the incision is begun at the lateral skin margins, bleeding can mask the area, making the incision at the outlet more difficult to define. When the first incision is made at the outlet, a small pack can be placed into the vagina to control the bleeding while the elliptic incision at the outer skin margins of the lesion is made. Keeping tension on either side of the incision facilitates this procedure. The line of resection laterally depends on the extent of disease but may include all of the labia majora. The incision is carried down from the lower mons to the lateral aspect of the labia majora. This is continued to the lowest border of the labia majus, then across the perineum to the opposite side. The incision is brought upward on the opposite lateral margin of the labium in order to reach the starting point on the mons. Vasopressin 1:100 solution is injected along the shallow cut edges of the incision. The incision is then carried into the fat to a depth of approximately 4-5 mm (from the surface). If the clitoris and labia minora are not involved, they should be preserved. Similarly, if the vestibule is not involved, it should be preserved. If the labia minora, vestibule and clitoris are involved in the intraepithelial neoplasia, then the incision should include these structures.[11]

The skin edges are held and elevated with forceps and the skin is dissected off the subcutaneous tissues. Traction and counter traction are exceedingly important to ensure uniform thickness of the tissue to be removed. The dissection progresses from above downward and from lateral to medial. Because the lesions for which conservative vulvectomy is performed are superficial, dissection does not need to extend down to the deep fascia or to the muscles of the urogenital diaphragm. Although it is unnecessary to remove the bulbocavernous and ischiocavernous muscles, it may be difficult to avoid these structures when the vulva is quite atrophic. Removal of some of the adipose tissue, particularly in obese patient, allows for better approximation of the skin edges to the vaginal mucosa. The body of clitoris should be preserved. If the hood and glans are involved and have biopsy proven carcinoma *in situ*, then the glans clitoris, the sheath and the frenulum should be excised with the labia minora. The body of the clitoris should not be exteriorized. The incision can be carried almost to the anal orifice; careful dissection here is important, so that the external anal sphincter is not damaged. If the disease extends onto the anal mucosa or the protruding hemorrhoidal tissue, the mucosa should first be carefully dissected from the underlying external sphincter, excised with tumor-free margins, and sutured to the perianal skin with 3-0 delayed absorbable material.[12]

Electrosurgical coagulation and dissection should be avoided in this area since it devitalizes tissues and increases the risk of necrotizing fasciitis. The dissection is then carried to the vaginal margin which is then circumscribed. It is helpful to orient the specimen for the pathologist and to draw a diaphragm on the pathology form marking the sites of disease if these are not clearly apparent (Fig. 19.3).

Hemostasis is assured by clamping and ligating the vessels using Vicryl 3-0. Major bleeding concerns may arise at the clitoris, particularly from the dorsal vein.

Fig. 19.3: The gross specimen of the vulvar tissue showing the verrucous growth removed during simple vulvectomy

Hemostatic sutures must be used to control the bleeding. A second point of concern is the pudendal vessels, which enter at the lower one third of the vulva close to the opening of the Bartholin duct. Branches of the pudendal vessels extend down to the anus as the inferior hemorrhoidals, and bleeding may be profuse in this area[11,12] (see Chapter 1).

Closure

If primary closure can be accomplished without excessive tension on the suture line, then this type of closure is preferred (Fig. 19.4), otherwise a split thickness graft should be applied to the defect and sutured medially to the vaginal margins and laterally to the residual skin of vulva and perineum using Vicryl 1-0. Care should be taken not to cause deviation of the axis of the urethra. During closure of the perineal defect above the anal orifice and posterior vaginal introitus, the surgeon should evert the vaginal epithelium over the perineum in approximation to the anal orifice rather than suture the lateral skin edges snugly across the perineum and fourchette. Everting the vaginal mucosa allows for satisfactory coitus, whereas tightly approximated skin across the posterior fourchette may constrict the vaginal introitus and predispose to pain, dyspareunia and fissuring.

Detailed procedure of skinning vulvectomy is depicted through Figures 19.5A to J.

If bleeding is a problem, a small drain can be placed at the lower end of the incision, but it is much better to achieve meticulous hemostasis and use a firm packing for 24 hours. Unfortunately, the wounds cannot be

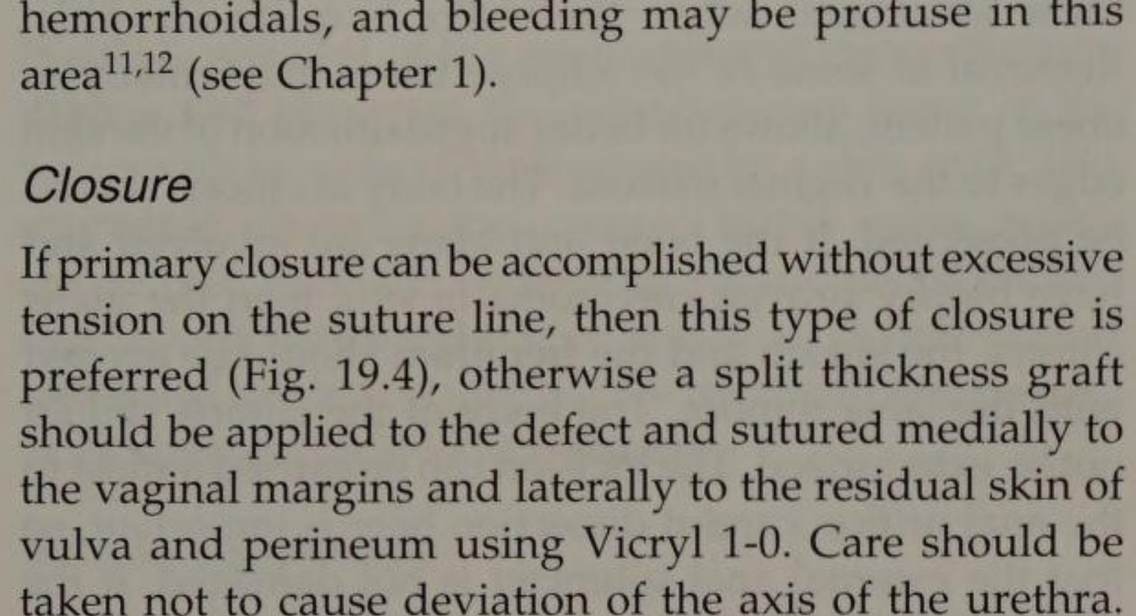

Fig. 19.4: Perineum after simple vulvectomy where primary closure has been accomplished

Fig. 19.5A: Defining the incision line after application of 5% acetic acid

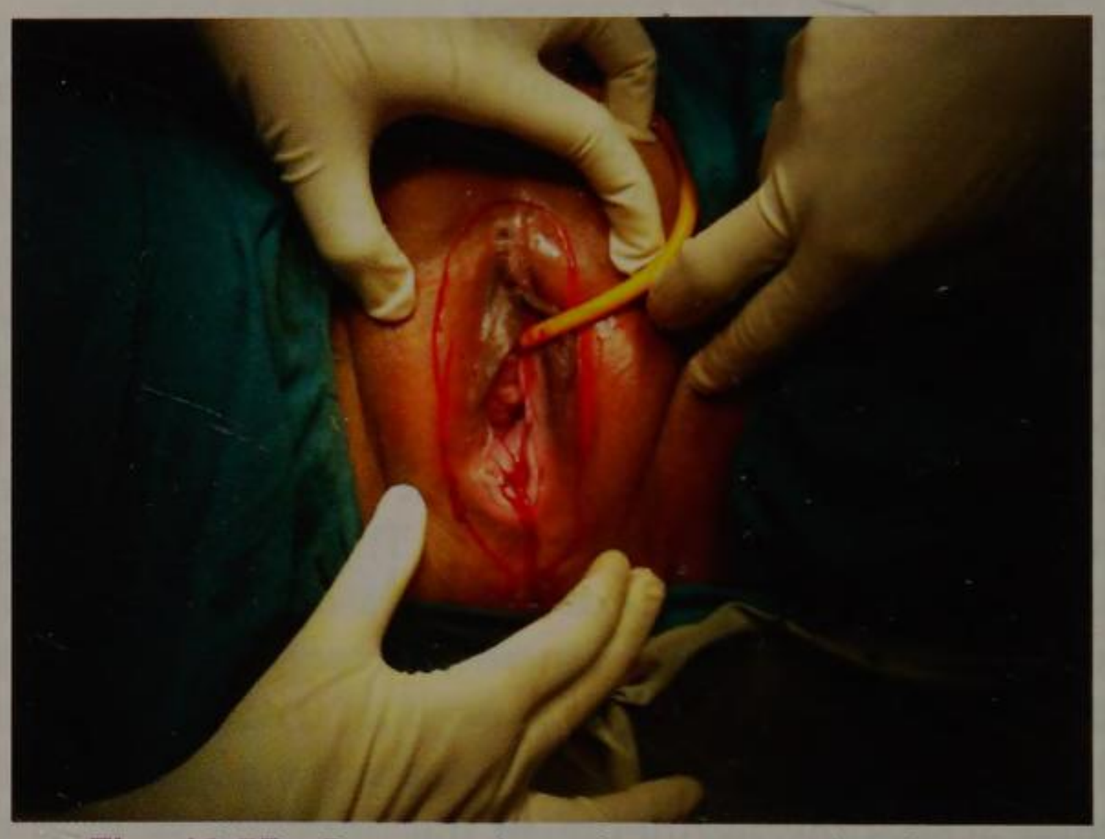

Fig. 19.5B: Demarcation of outer margin of area to be removed

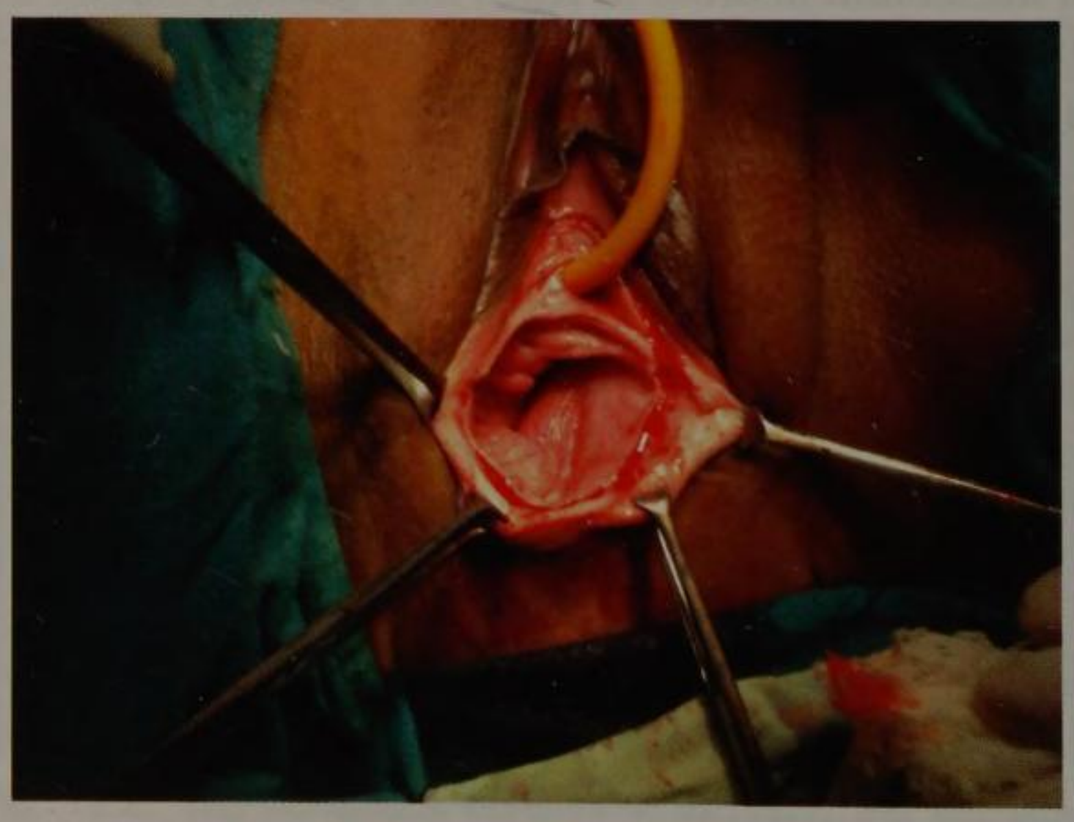

Fig. 19.5C: Highlighting the inner edge of the area to be removed

Fig. 19.5D: Dissection to separate the inner edge

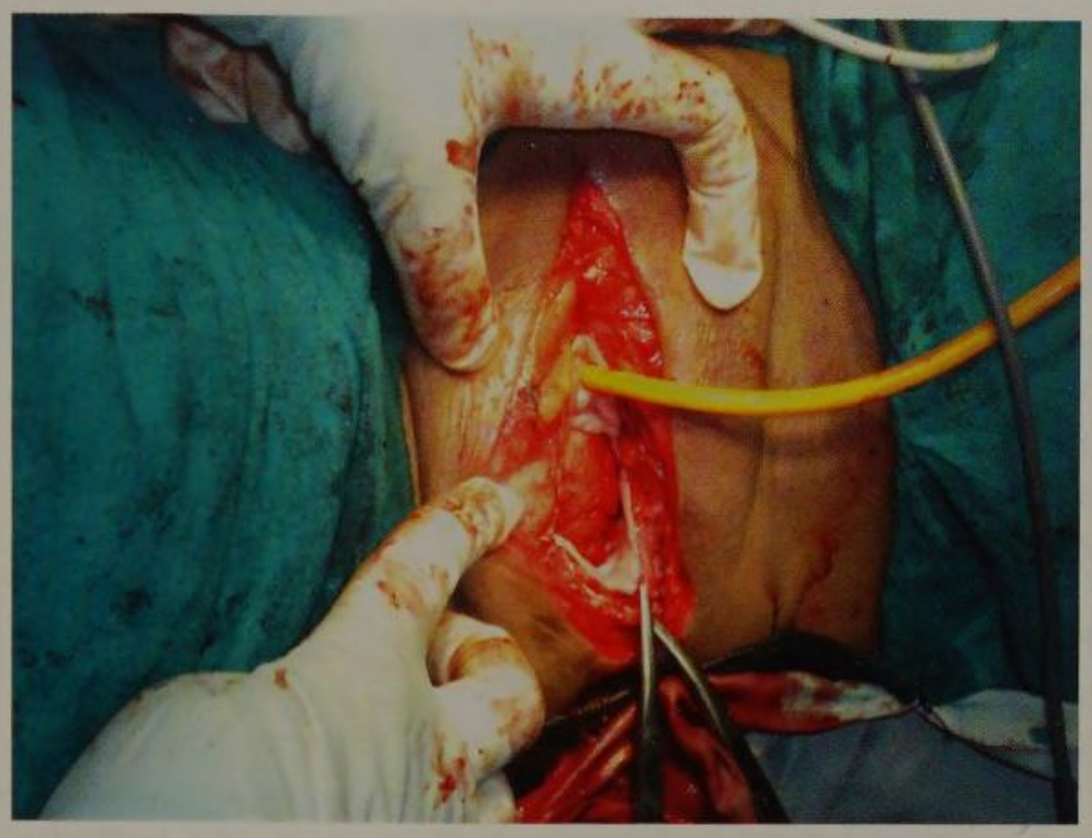

Fig. 19.5G: Perineum after complete excision

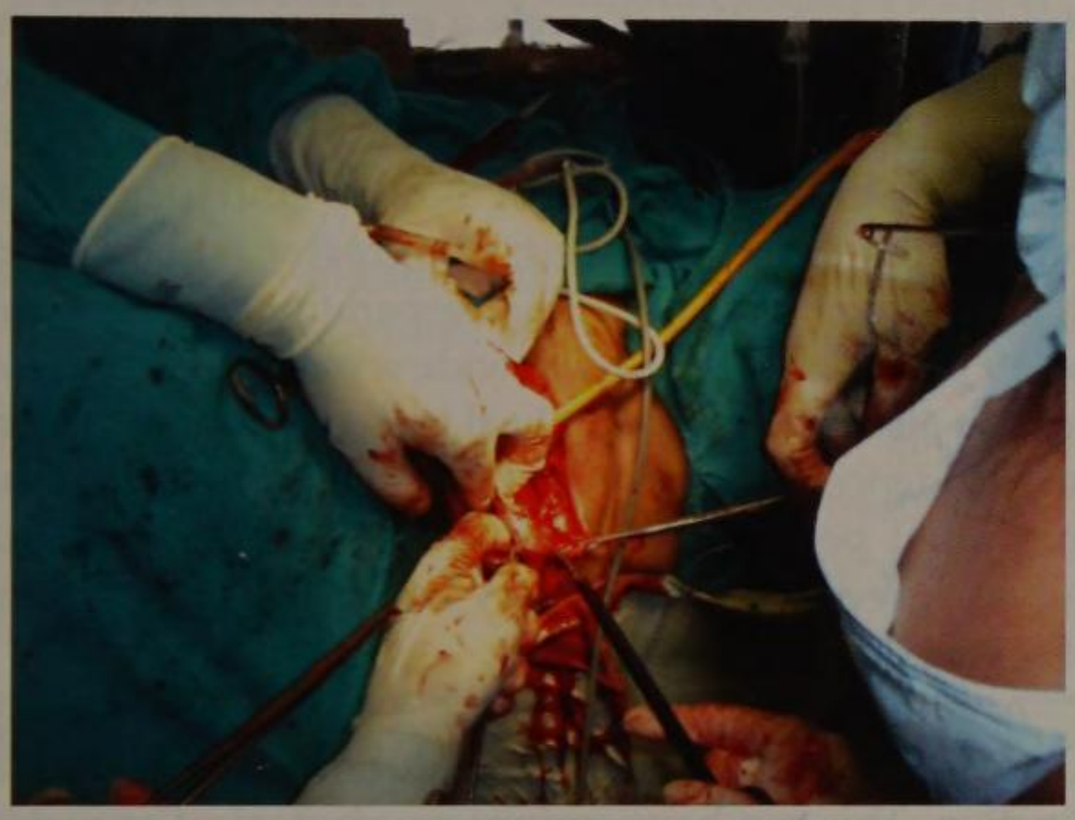

Fig. 19.5E: Dissecting out the skin epidermis from underlying fat

Fig. 19.5H: Suturing in process with '0' vicryl

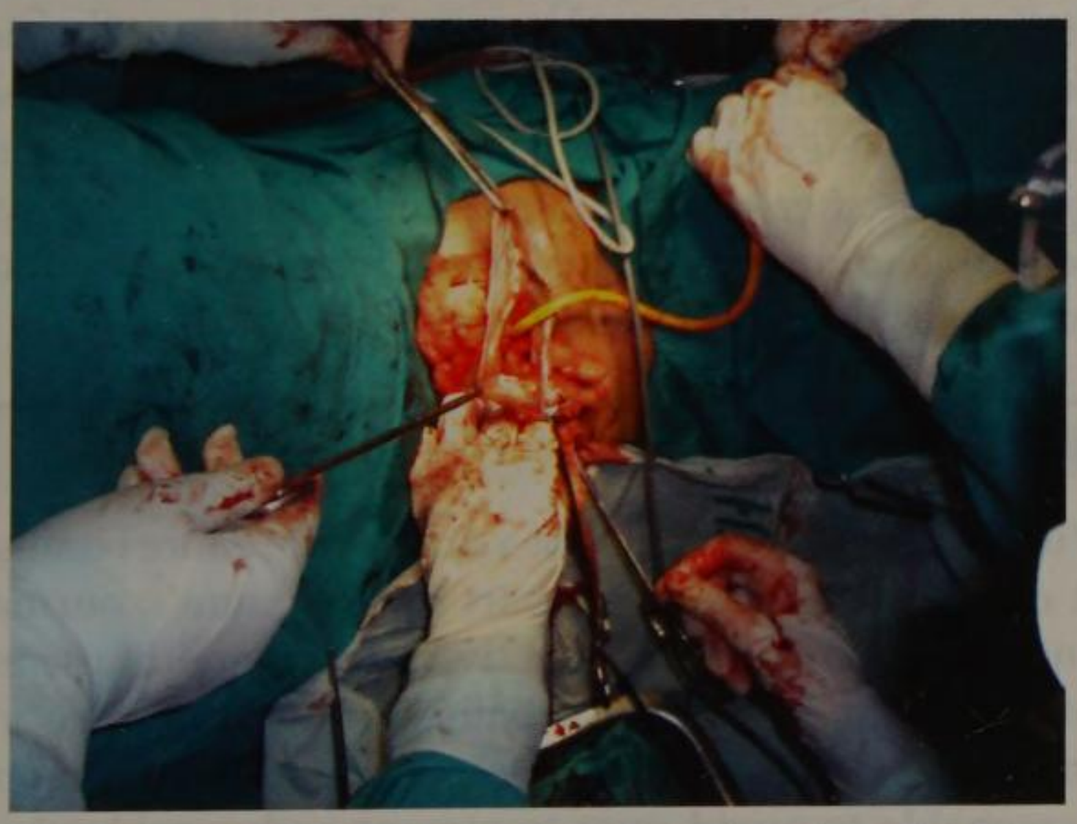

Fig. 19.5F: Highlights the posterior dissection

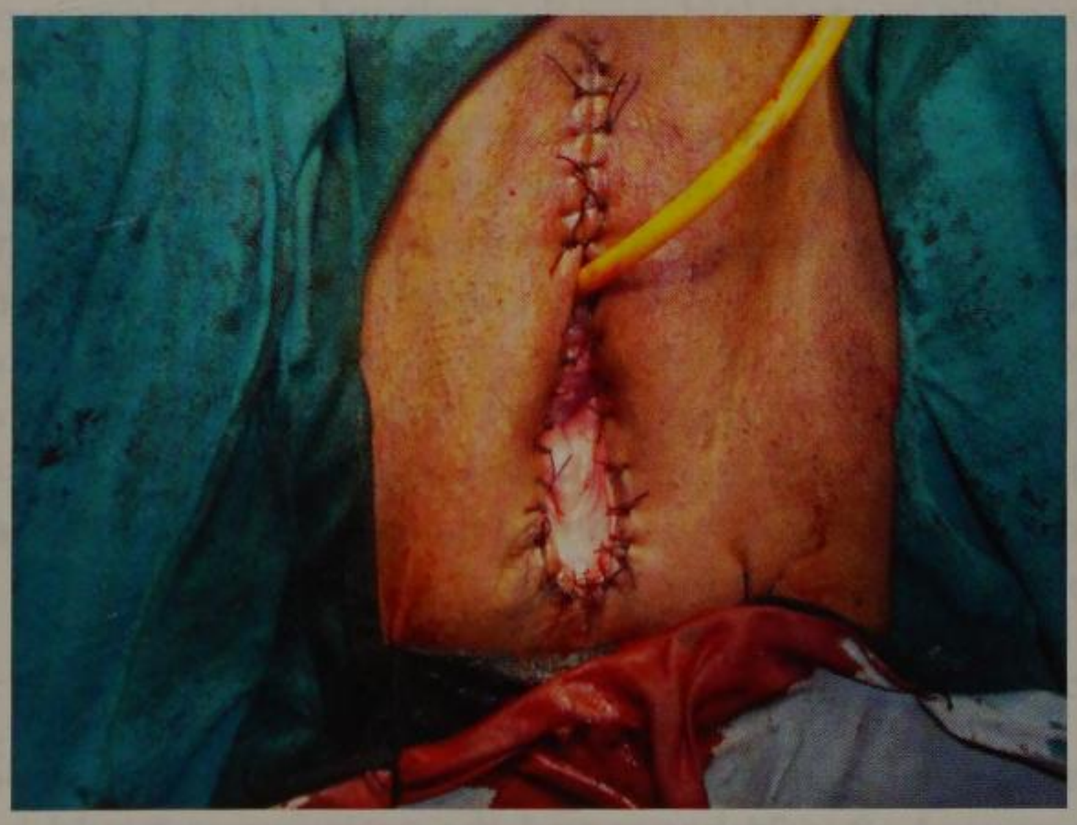

Fig. 19.5I: Vulva at the end of procedure

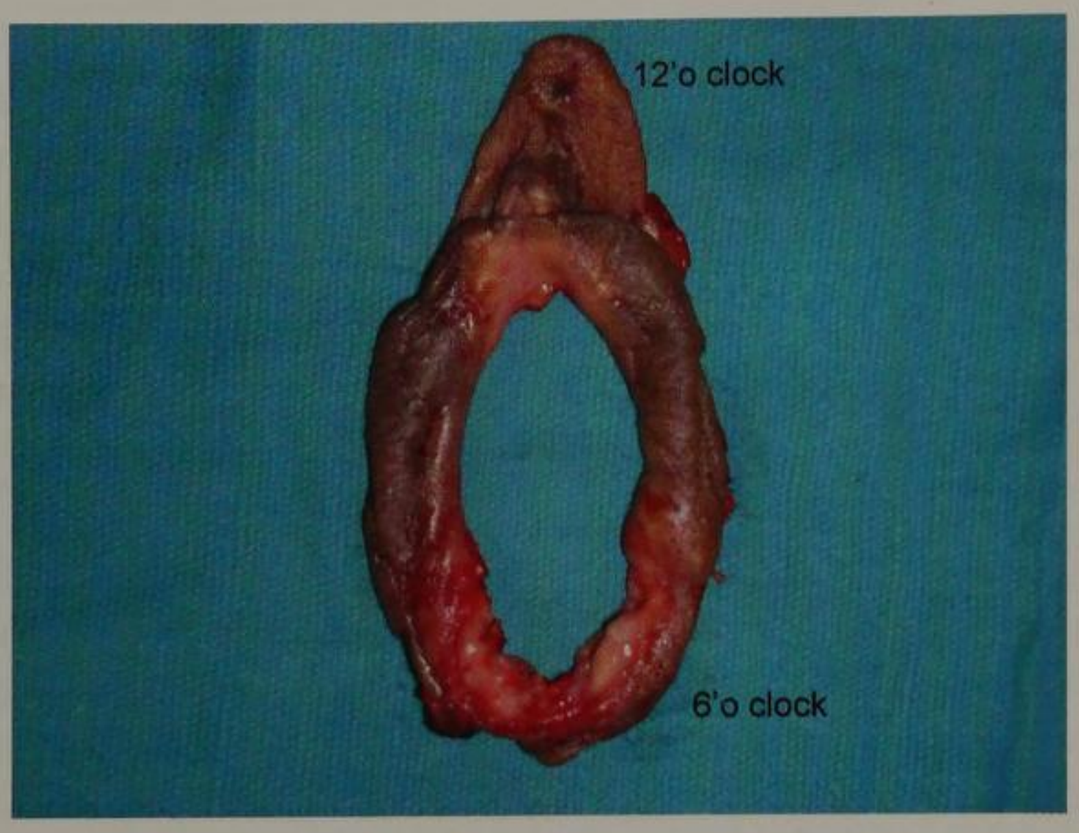

Fig. 19.5J: Specimen showing white lesion at 12 O'clock and 6 O'clock

Figs 19.5A to J: Steps of skinning vulvectomy done for VIN-III

practically dressed. The operative site should be covered with antiseptic cream three times a day and at bedtime when primary closure has been implemented.

Vulval Reconstruction

A split-thickness skin graft is taken from the inner thigh and meshed in order to increase the area that can be covered and prevent clot and exudate accumulating under the graft. It is important to ensure good hemostasis before the graft is applied. The undersurface of the graft is applied to the defect and the edges secured to the wound edges using 3-0 polyglactin (Vicryl Ethicon). A paraffin gauze is laid over the graft and cotton dressings are secured over the top to maintain apposition. A few sutures are left long on each side to use for tying down the dressing at the end of the procedure. Paraffin gauze and dressings are placed over the donor site on the thigh, which is then wrapped in a crepe bandage. Excess skin is refrigerated in case the first graft does not take completely.[13,14] When graft has been applied, a pressure dressing consisting of fine mesh gauze followed by 4 × 4 inch sterile gauze pads should be applied and remain in place undisturbed for 1 week.

Postoperative Care

In case of primary closure, vaginal pack should be removed after 24 hours and the entire area should be exposed. Initial application of ice-packs to the operative site for 24 to 48 hours seems to provide more comfort to the patient than heat.[12] Later, warm air blown across the perineum is both comforting and therapeutic because it helps to keep the operative site dry and stimulates blood flow, enhancing the healing process. Frequent sitz baths are recommended. Patients should dry the vulva completely after each sitz bath. Patient is allowed out of bed to chair at an early stage but is not allowed to walk freely. Climbing of stairs and abduction of legs are prohibited. A Foley's catheter may be needed for a prolonged period after surgery while the suture line undergoes initial healing of the skin edges.[9] Heparin or pneumatic compression stockings should be used in high risk women to prevent postoperative venous thrombosis.

Complications and Side Effects of Vulvar Surgery

Hematoma formation is rarely a problem, provided the suction drain works well. Removal of wide areas of vulvar skin may result in wound infections, failure of the wound to heal or failure of the skin graft to take. The more is the tissue removed, the greater is the risk of significant complications. Small separation of wound can be left to heal spontaneously; wide separation is unusual but can also be left open to heal by secondary intention. Any evidence of infection is treated with antibiotics and continued perineal hygiene. Other complications of vulvar surgery include urinary infection and reduction of sexual desire or pleasure.[15]

Although surgery has few long-term complications, it can be disfiguring and may significantly impact sexual function. This can have serious psychological sequelae, even in the absence of a functional problem after surgery. Sexual dysfunction seems to be related to a disturbance in body image, leading to hypoactive sexual disorder and aversion disorder. Depression and increasing age are risk factors for sexually active women to discontinue intercourse after surgery. Interestingly, few studies have been able to correlate sexual dysfunction with extent of surgery if the clitoris was preserved.[16]

CONCLUSIONS

Vulvectomy of any sort is not a simple procedure because it destroys an important part of a woman's normal anatomy. Subsequent sexual dysfunction and the sense of disfigurement that many patients suffer in silence are important morbidities. Keeping this in mind, it may be reasonable to avoid over treatment and consider less disfiguring procedures like simple vulcectomy wherever

possible and confine the use of more radical vulvectomy only where indicated.

Key Points

1. Simple vulvectomy involves removal of the entire vulva including epidermis, dermis and the underlying fat.
2. Common indications for simple vulvectomy include extensive Paget's disease and widespread recurrent VIN where malignancy cannot be ruled out.
3. Achieving meticulous hemostasis is the key for a smoother post-operative course.
4. Vulvar reconstruction with skin grafts is required when the defect is large and primary closure cannot be accomplished without excessive tension on the suture line.
5. Prolonged urethral catheterization may be needed after the surgery while the suture line undergoes initial healing.
6. Surgical complications are rare and include wound hematoma, infections and failure of the skin graft to take.
7. However, the surgery can have serious psychological sequelae causing sexual dysfunction leading to hypoactive sexual disorder and aversion disorder.

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20 Radical Vulvectomy with Groin Dissection

K Chitrathara, Rema P

INTRODUCTION

Vulvar cancer represents approximately 4% of all female genital tract cancers and 1 to 1.5 % of all female malignancies. Lymphatic spread occurs in 30-40% of cases of carcinoma vulva primarily to inguinal lymph nodes and then sequentially to pelvic lymph nodes. Blood borne spread is rare. The main cause of failure in treatment of carcinoma vulva is inability to control lymphatic and distant metastasis. In node negative patients clearance of tumor bearing area and thus control of local disease dictates the outcome.

RADICAL VULVECTOMY

History

No other gynecological cancer has undergone so much change in management as vulvar cancer. The changes mirror that of the surgical management of cancer breast. Basset first described a vulvectomy combined with groin dissection in 1912. After the pioneering work of Taussig in United States and Way in Great Britain en-bloc radical vulvectomy and bilateral ilioinguinal dissection became the standard treatment of most patients with operable vulvar cancer. If the disease involved the anus, rectovaginal septum or proximal urethra, some type of pelvic exenteration was combined with the dissection.

En-bloc radical vulvectomy with a butterfly incision carried significant morbidity. Surgery was very mutilating and distressing to the patient as the wound breakdown rate was very high.

Taking these factors into consideration refinements has been made to the traditional surgery. These include:

1. Definition of preinvasive cancer that does not require radical dissection or lymph node dissection.
2. Limiting the inguinal node dissection to one side in early cancers.
3. Using a triple incision technique instead of en-bloc dissection to improve wound healing.[1]
4. Sparing of the saphenous vein in an attempt to prevent lymphedema.
5. Elimination of routine pelvic lymphadenectomy.
6. Sentinal node dissection is currently being studied and may eventually replace groin dissection.
7. The use of preoperative radiotherapy to avoid exenteration in patients with advanced disease.
8. The use of postoperative radiation treatment to decrease the incidence of groin recurrence in patients multiple positive groin nodes.

MANAGEMENT OF PRIMARY LESION

Understanding of oncologic principles led to the evolvement of more conservative surgery. The terminologies used interchangeably are wide local excision (WLE), radical wide excision (RWE), modified radical surgery, vulvar-sparing surgery. WLE and RWE are self-implying terminologies suggesting adequate local clearance. The depth of invasion is not of much clinical significance, since even in conservative surgery the deep clearance should be to the level of inferior fascia of urogenital diaphragm. So the main factor, which decides the extent of local resection, is the condition of the remainder of the vulva. If the remainder of the vulva is healthy radical wide excision is the appropriate treatment with attention to give at least 1cm clearance.[2] Local recurrence is the most common form of vulvar cancer recurrence.[3] Margin of less than 0.8 cm is

associated with a 50% chance of recurrence (Heaps). This applies to lesions close to urethra where upto 1 cm of distal urethra can safely be removed for clearance. If adequate clearance cannot be obtained by resection of distal one-third of urethra, radiation or combined modality is considered as the primary treatment and surgery is reserved for residual/recurrent lesions. If the lesion is close to introitus adequate vagina has to be removed, if near the labiocrural fold the resection should extend to the thigh for clearance. Effect of radical surgery is limited by the closest surgical margin rather than the achievement of total organ ablation. Tumor within 5 cm of anal verge (perianal area) is better treated by chemo-radiation.

In discussing skin squamous cell carcinoma Motley et al observed that a larger tumour had greater microscopic tumor extension and should be removed with a wider margin. Poorly differentiated tumors have poor prognosis with more than double the local recurrence rate. So it is prudent to go for a wider margin of 2 cm in above situations and also in malignant melanoma of vulva.[4,5]

Hoffman MS[6] et.al conducted a comparative analysis of 45 patients who had undergone radical vulvectomy with 45 patients of modified radical vulvectomy. He quoted a 2.2% local recurrence in the modified radical vulvectomy group and 4.4 % in radical vulvectomy group. Other complications were comparable. He concluded that modified radical vulvectomy appears to be efficacious for the vulvar phase of treatment of invasive squamous cell carcinoma.

In skinning vulvectomy only the top layer of skin affected by the cancer is removed, and is used in treatment of high grade vaginal intraepithelial neoplasia (VIN3).

Partial radical vulvectomy—Part of vulva including deep fascia is removed.

SURGICAL TECHNIQUE

Preoperative Preparation

Thrombo-embolic prophylaxis is needed because the patients are usually obese, old, with CVS diseases.
Prophylactic antibiotics to reduce the incidence of infection.

Anaesthesia

Spinal/epidural preferred because it decreases intra-operative blood loss and avoids the hazards of general anesthesia in old and infirm patients.

Fig. 20.1: Ulcerative lesion in the lower lateral part of clitoris:
1. Lesion

RADICAL VULVECTOMY

Technique

Vulvar incision is varied according to the size and extent of the lesion (Fig. 20.1). Separate incisions for groin and vulva are used which reduce the morbidity significantly with no increase in skin bridge thickness.[7-10]
The basic principles are:

1. A wide margin of normal skin surrounding the cancer should be removed. It is important to bear in mind that paraffin embedded tissue shrinks by 25%, thus at the time of radical vulvectomy at least 1-1.5 cm of grossly negative margin should be obtained down to the level of inferior margin of urogenital diaphragm.
2. The margin should be adequate both laterally and medially.
3. All dystrophic skin should be removed with the specimen.

Elliptical lateral incision is made commencing anteriorly at the mons pubis passing posteriorly along each labiocrural fold ending at the perineal body. The anus is skirted by a curved incision. The lateral incision is carried down to the muscle fascia. Urethra and vagina are now encircled by the inner incision. This passes around the introitus anterior to the urethra. If the lesion is close to the urethra lower 1 cm of urethra should be removed.

Lateral incisions are deepened down to the deep fascia and the entire vulva is removed (Figs 20.2 and 20.3). Bleeding occurs mainly from three sites; the ends of

Fig. 20.2: Excised specimen: Radical wide excision of the lesion along with excision of the remaining unhealthy vulva. Note the deep clearance of the lesion and unhealthy area of rest of vulva
1. Lesion
2. Deeper resected tissue
3. Pruritic skin of rest of vulva
4. Healthy skin
5. Upper part of resected specimen

Fig. 20.3: Resected bed of vulva:
1. Urethra

external pudendal vessels, vascular tissue at the base of the clitoris. They are controlled by cauterization or suturing.

Primary closure is usually feasible after putting a closed suction drain.

GROIN DISSECTION

Appropriate groin dissection is the single most important factor in decreasing mortality from early vulvar cancer.

When a prophylactic lymphadenectomy is contemplated an understanding of the topography of inguinal nodes helps in carrying out an 'adequate clearance.' This will limit the unwanted side effects and morbidity. Nicklin and colleagues[11] by studying bipedal lymphangiogram confirmed that inguinal nodes were situated in the femoral triangle. No nodes were demonstrated medial to pubic tubercle and in the outer 15-20% of a line drawn from anterior superior iliac spine to pubic tubercle.

Borgno and colleagues[12] reported that femoral nodes are 1-4 in number and lie on the medial side of the femoral vein within the fossa ovalis. No nodes were located distal to the lower margin of fossa ovalis and none was located lateral to femoral vein. The most cephalad node is node of Cloquet or Rosenmuller. From these findings it is clear that there is no need to remove facia lata lateral to femoral vessels, no need to clear beyond the apex of femoral triangle. These modifications along with suphenous vein sparing is termed as modified groin dissection.

Sentinel Lymph Node Dissection in Vulvar Cancer

Sentinel node is the first echelon node. The hypothesis is that if sentinel node is negative, all other nodes will be negative, so the patient could be spared of the morbidity of groin dissection. Sentinel node concept in vulvar cancer was first defined by Levenback.[13]

Method

Intradermal injection of Isosulphan blue dye is done and lymph nodes are identified by the blue staining. The other method is injection of intradermal radioactive^{99} Tc labelled sulphur colloid. Peritumoral injection is used commonly. Sentinel node is detected by the lympho-scintigraphy. Peroperatively it is again localized by hand held collimated gamma counter. Data at this stage is preliminary. Initial results demonstrated a high accuracy,[14-15] further studies reported false negative results.[16-17] Women with early stage cancer can be enrolled into clinical trial of sentinel lymphnode dissection.

Indications of Groin Dissection

All patients with tumour of more than 1 mm stromal invasion need inguino-femoral lymphadanectomy. There is no role for superficial inguinal dissection.[18] If groin dissection is needed, it should be a thorough inguino-femoral lymphadenectomy. Radiation treatment cannot

substitute groin dissection even in patients with clinically non-suspicious nodes. The recurrence in undissected groin carries about 90% mortality.[19]

Burger et al defined medial and lateralized lesions. Tumors with a medial margin of >1 cm from midline structures are lateralized lesions. All others are midline tumors.

In *lateralized lesions* with negative ipsilateral lymph nodes the incidence of involved contralateral lymph node is < 1% in patients with early stage disease.[21] Thus, there is no need for contra-lateral groin dissection in such cases. If bulky ipsilateral lymph nodes or multiple microscopic ipsilateral lymph nodes are positive, contralateral groin dissection should be done.

However, in *midline lesions* bilateral groin dissection should be done. Recruiting these patients to sentinel lymph node clinical trials is a good alternative, which reduces the morbidity of bilateral groin dissection.

Pelvic lymphadenectomy should be done if > 3 groin nodes are pathologically positive or clinically bulky pelvic lymph nodes are present.

Incision

Lazy S incision extending two centimeters above the inguinal ligament through the mid inguinal point to the apex of femoral triangle or horizontal incision 1 cm below and parallel to the groin crease (Fig. 20.4).

Mac fee incision: Two parallel incisions in the groin, seldom used because of increased chance of the intervening skin necrosis

Pelvic lymphadenectomy can be best accomplished through a lower midline extraperitoneal approach, or by any of the above incisions.

TECHNIQUE (FIGS 20.5 TO 20.13)

Incise through skin and subcutaneous tissue to the level of Scarpa fascia. The inguinal nodes lie between the superficial fascia and fascia lata. When the oblique incision is used the superior flap is developed deep to Scarpa's fascia for a distance of 8 cm.

The inferior flap is now developed for a distance of 6 cm below the incision. The saphenous vein is seen in the center of the field, emerging from the package of lymph node bearing tissue and is seen entering the femoral vein 3 cm below the inguinal ligament. This tissue is dissected off the fascia lata and the fossa ovalis in the lateral to medial fashion. The saphenous vein is carefully

Fig. 20.4: Lazy S incision in Rt Inguinal region: 1. Taking the curve of lower part of incision

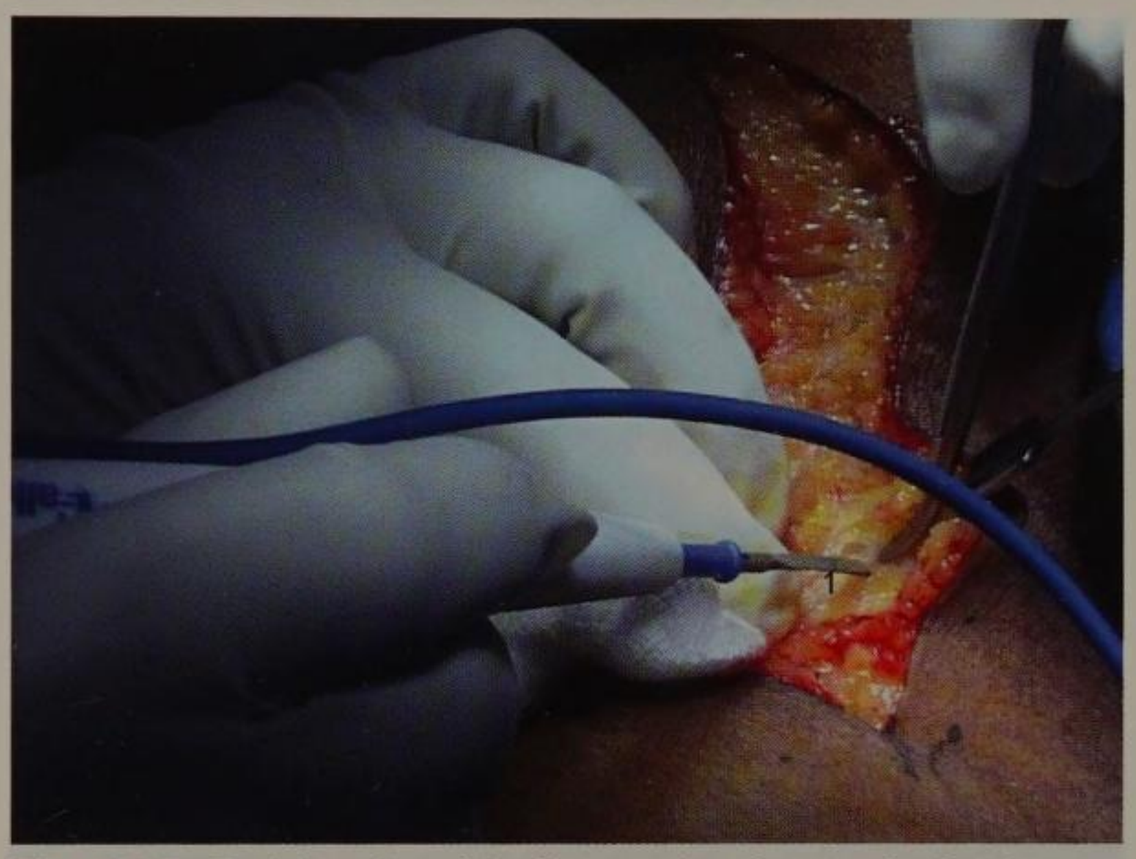

Fig. 20.5: Raising the skin flap under Camper's fascia: 1. Camper's fascia

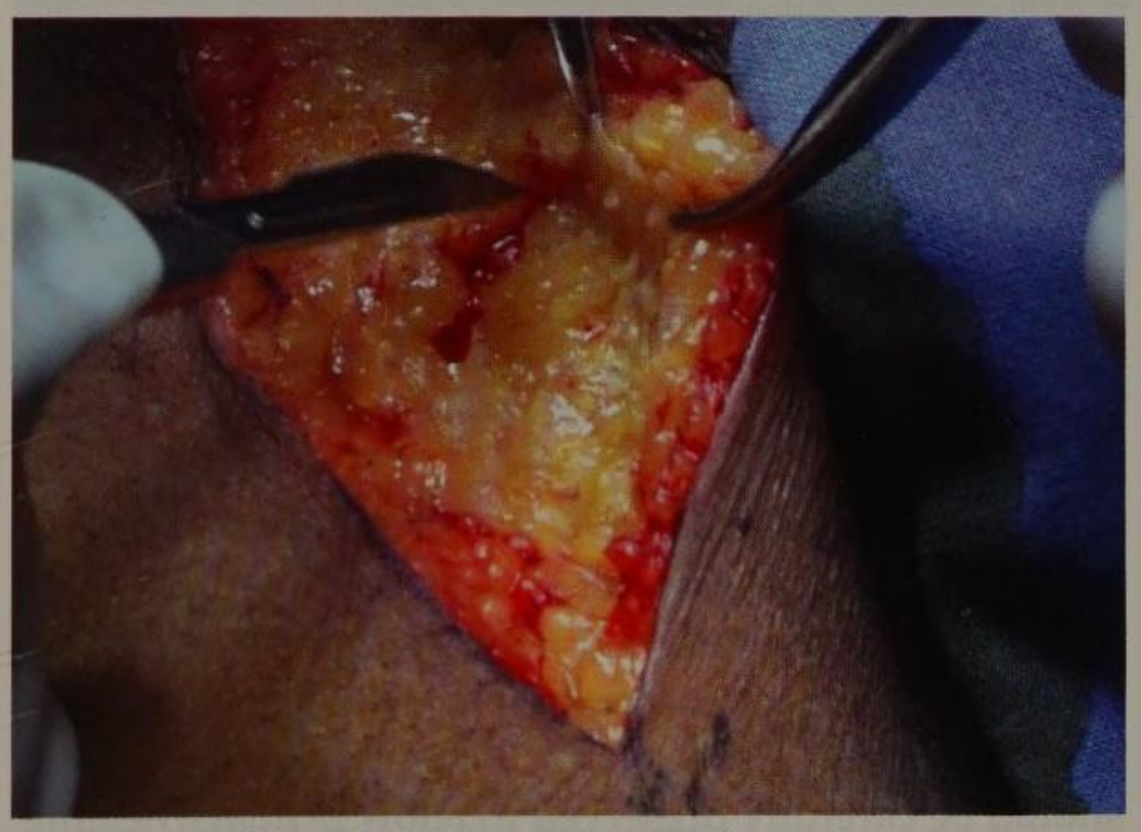

Fig. 20.6: Flap raising with scalpel

Fig. 20.7: Raising the flap continued showing the node bearing fat under the Scarpa's fascia

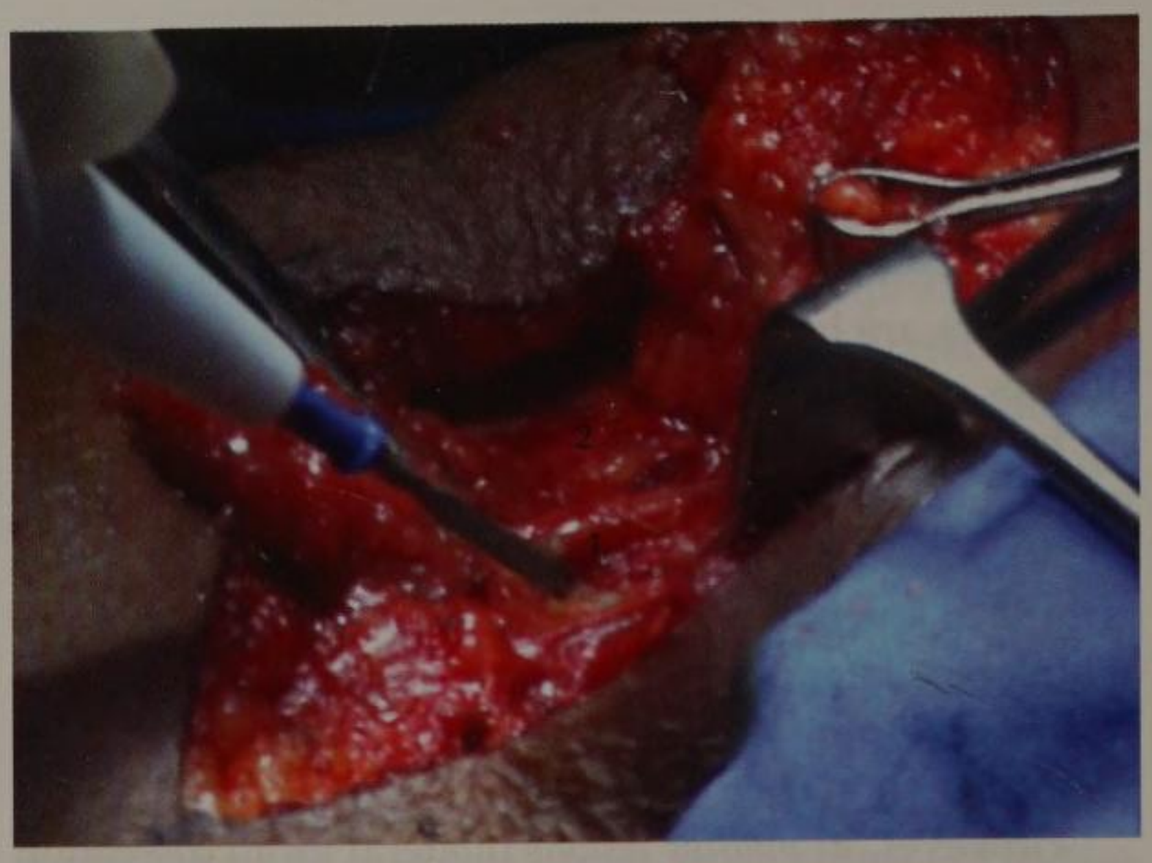

Fig. 20.9: Dissection proceeding. Dissecting the Saphenous vein and sapheno femoral junction
1. Femoral artery 2. Iliopsoas muscle

Fig. 20.8: Node bearing tissue is raised from external oblique aponeurosis
1. External oblique aponeurosis 2. Lateral skin flap

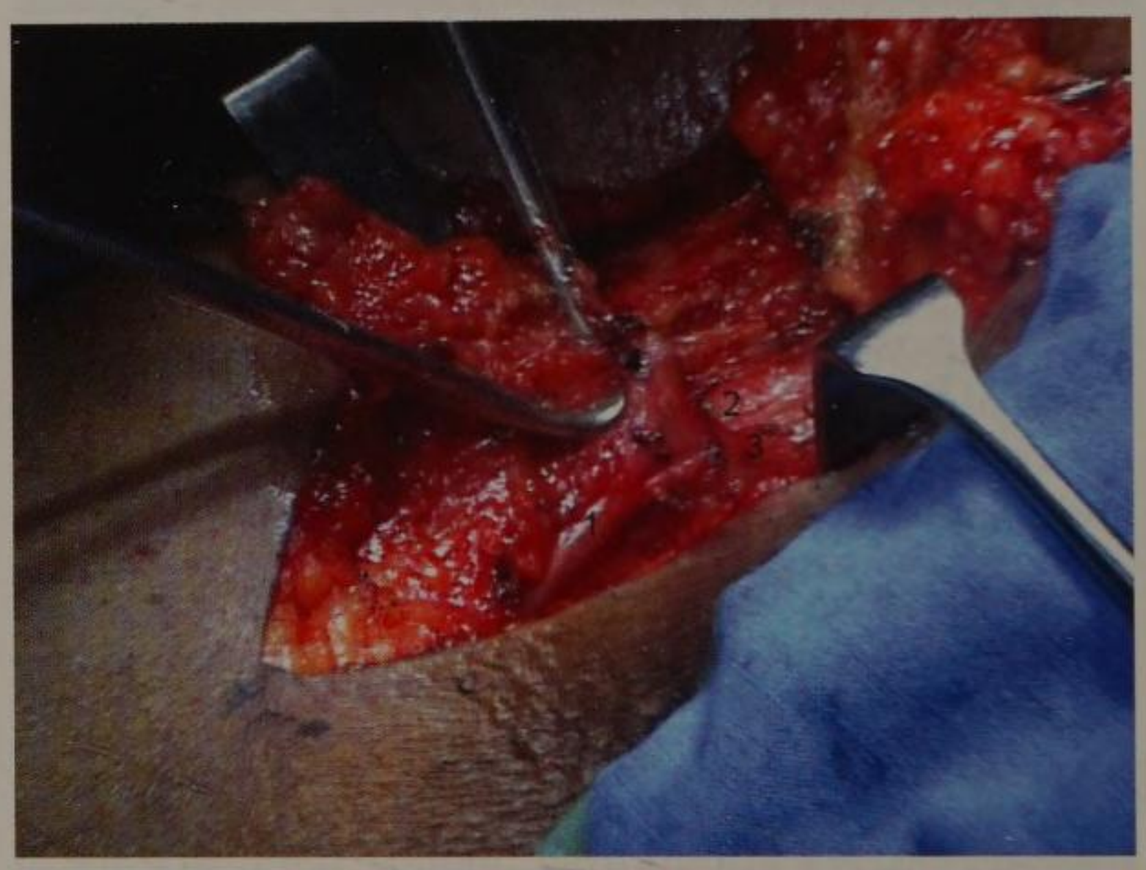

Fig. 20.10: Dissecting sapheno-femoral junction
1. Saphenous vein
2. Femoral artery
3. Femoral vein
4. Another tributary of femoral vein opposite sapheno femoral junction

preserved. The superficial inguinal lymph nodes are then dissected laterally and off the sapheno-femoral junction and surrounding surfaces. As the dissection proceeds, the numerous lymphatic channels encountered are isolated and ligated or cauterized.

The deep inguinal nodes, clustered around the femoral vessels, are dissected superiorly to the level of the inguinal ligament and excised. At the end of the procedure, the saphenofemoral junction is intact. There are no lymph nodes in the subcutaneous fat and this layer should be carefully preserved to allow primary healing. Finally, the Cloquet's node is removed from the femoral canal.

Femoral canal is closed by the approximation of inguinal ligament to Coopers ligament, taking care not to compress femoral vein. Sartorius muscle is divided from its origin from inguinal ligament and is sutured to the inguinal ligament so that it protects the groin vessels. This prevents catastrophic bleeding which can occur if infection of the groin extends to the femoral vessels.

Fig. 20.11: Completed inguinal dissection
1. Femoral artery
2. Femoral vein and sapheno-femoral junction
3. Saphenous vein
4. Adductor longus
5. Sartorius
6. Apex of femoral triangle

Fig. 20.12: Femoral vein showing two major superficial veins joining before forming sapheno-femoral junction
1. Pectineus
2. Adductor longus
3. Saphenofemoral junction
4. Sartorius

Pelvic Lymphadenectomy

If groin incisions are used, there are three basic routes to this region described by Spratt and co-workers.[22] The inguinal ligament can be divided vertically over the vessels or at the anterior superior iliac spine. Another approach is incision of the external oblique fascia and, reflecting the spermatic cord cephalad, division of the inguinal floor from the internal ring to the pubic tubercle, with ligation of the inferior epigastric vessels. This maneuver permits wide pelvic and retroperitoneal access. The preferred approach is incision in the anterior abdominal musculature 4 to 5 cm above and parallel to the inguinal ligament with medial mobilization of the peritoneum. This approach widely exposes the iliac region for nodal dissection. The pelvic lymphadenectomy includes the distal common iliac, external iliac and obturator groups of nodes. No further therapeutic benefit is gained from proximal iliac or para-aortic dissection.

Closed suction drains are kept and skin is closed with mattress sutures or staples (Figs 20.14 to 20.22).

Closure of Defect on Vulvectomy and Groin Defect

Primary closure is achieved in most cases. In case of difficulty in approximation local flap like rhomboid flap or pedicled/free myocutaneous flap like tensor fascia lata (TFL), transeverse rectus abdominis (TRAM), Gracilis etc. can be used to cover the defect (Figs 20.23 to 20.25).

Postoperative Care

Broad spectrum prophylactic antibiotics are given to all patients and the patient is ambulated on the day

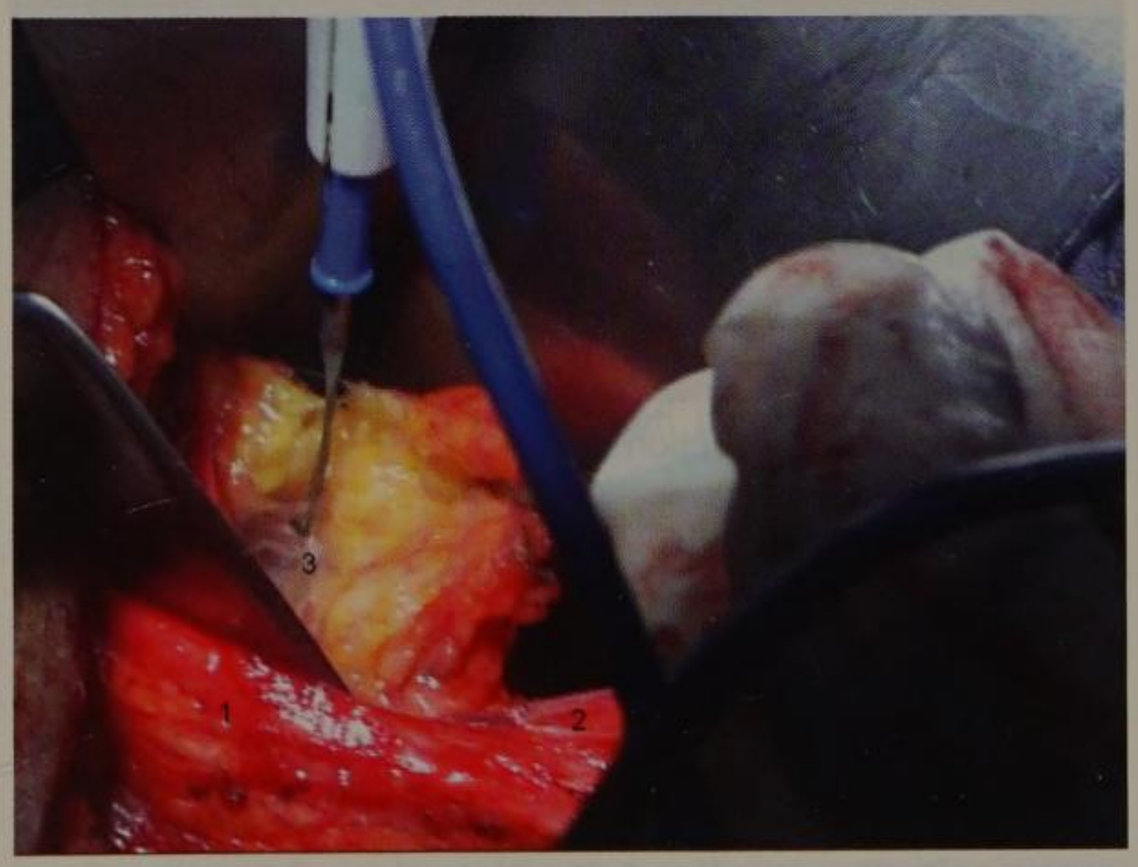

Fig. 20.13: Iliac dissection beginning
1. External oblique aponeurosis incised 4cm-5cm above inguinal canal
2. Internal oblique split in direction of its fibres
3. Fascia over psoas muscle, separating the node bearing area. Lateral to external iliac artery

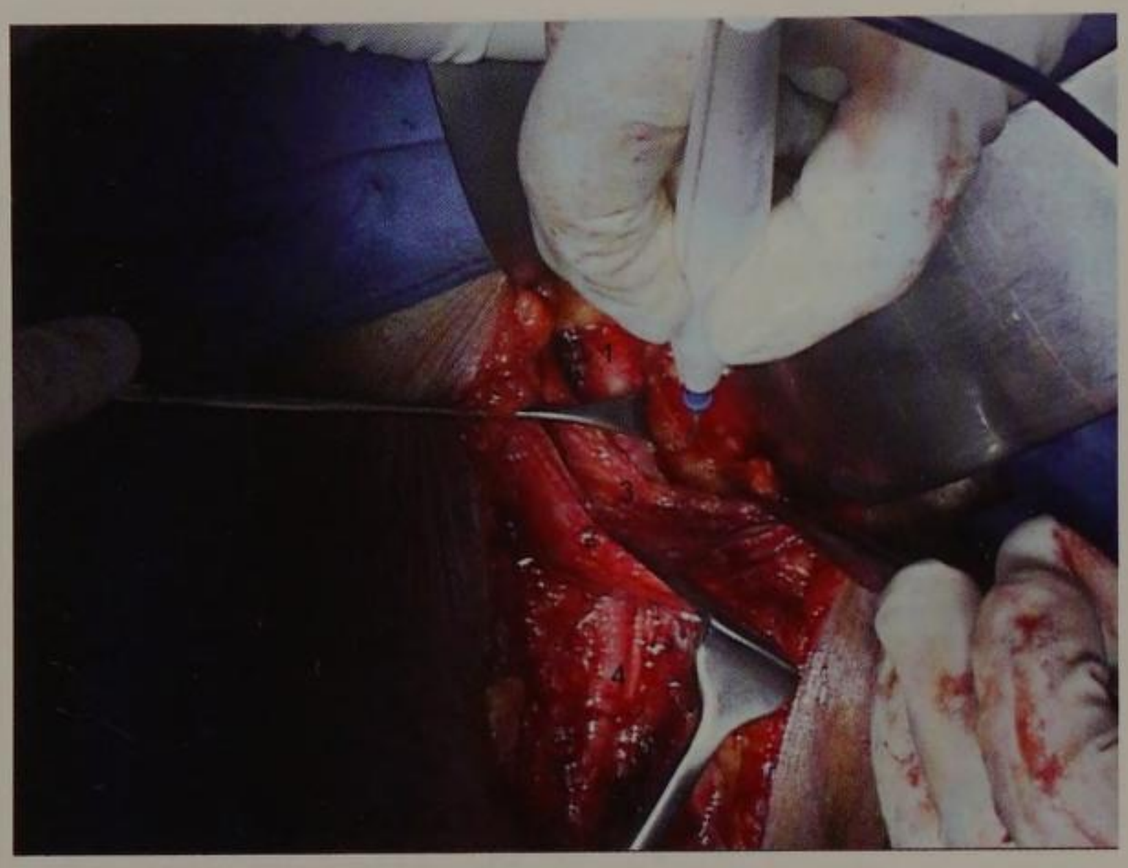

Fig. 20.14: Obturator fossa dissection
1. External iliac artery
2. External oblique aponeurosis
3. Internal oblique muscle
4. Femoral artery

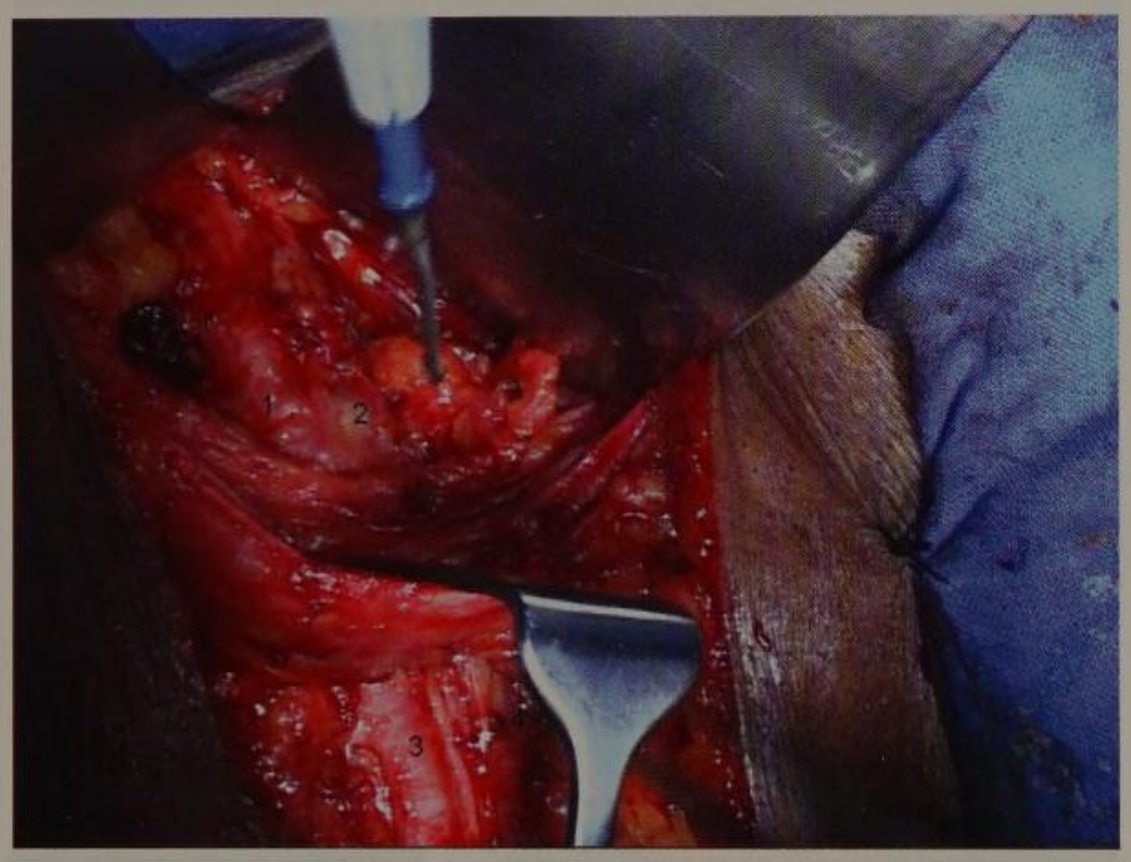

Fig. 20.15: Iliac dissection
1. External Iliac artery
2. External Iliac vein
3. Femoral artery
4. Femoral vein

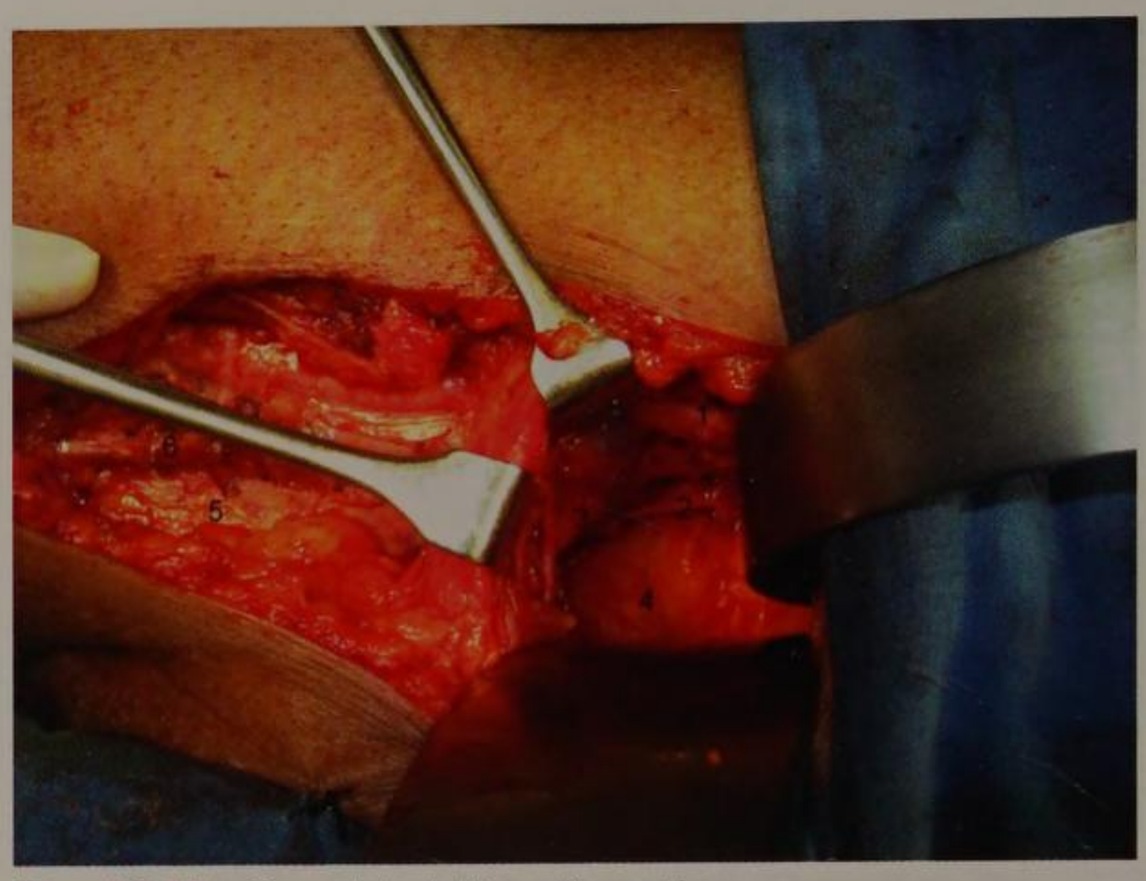

Fig. 20.16: Completed iliac dissection
1. External iliac artery
2. Obturator nerve
3. Pecten pubis
4. Adducter longus
5. Saphenous vein

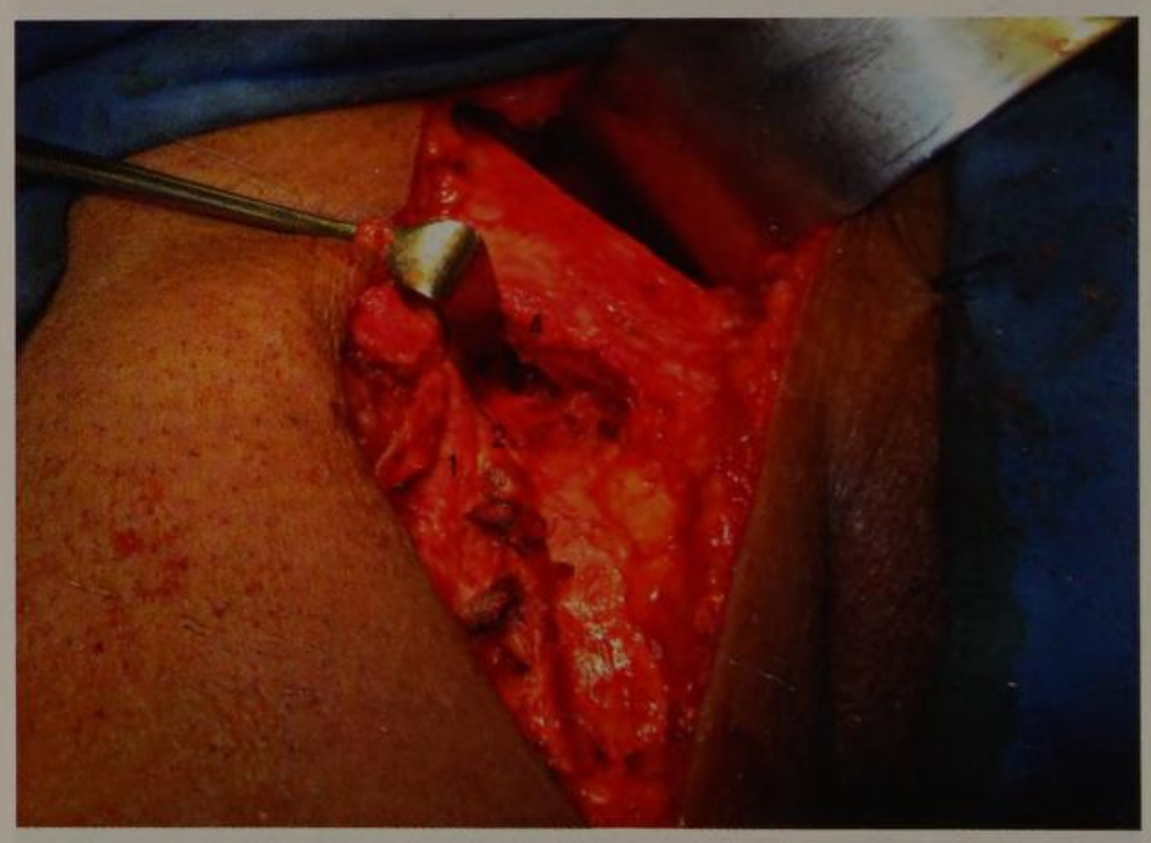

Fig. 20.17: Clearance of femoral canal; pelvis is viewed through the femoral ring
1. Femoral artery
2. Femoral vein
3. Femoral ring
4. Inguinal ligament

following surgery. Thromboembolic prophylaxis is continued till patient is fully ambulant. Foleys catheter is retained for few days if urethral excision was done. Suction drains are retained until drainage is less than 25-50 ml/day. Elastocrite bandage or leg stockings are worn if a lymphadenectomy is undertaken.

Complications

Immediate Complications

1. Skin edge necrosis.
2. Lymphocyst formation occurs in 10-20% of patients and can be treated by repeated aspiration.

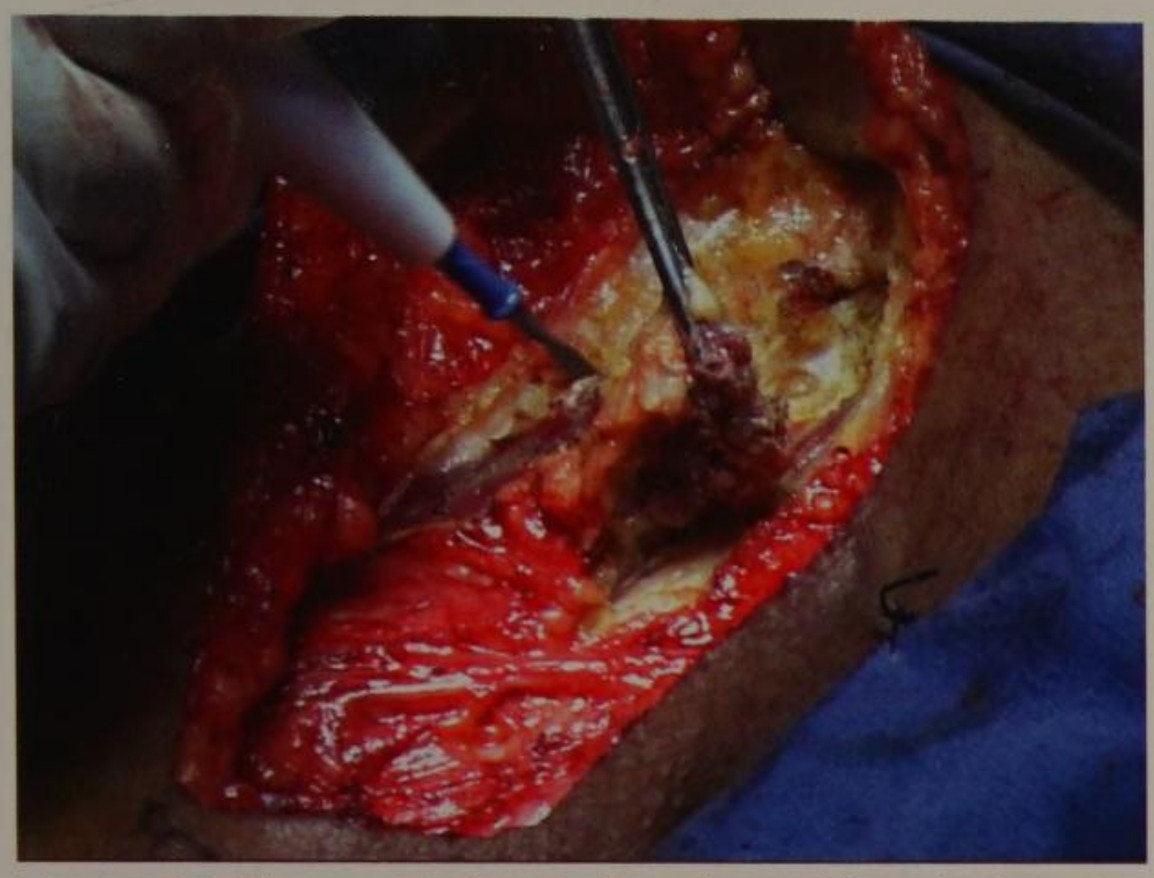

Fig. 20.18: Upper part of sartorius released from its insertion in the anterior superior iliac spine to cover the femoral vessels
1. Released insertion
2. Lateral part of sartorius being released

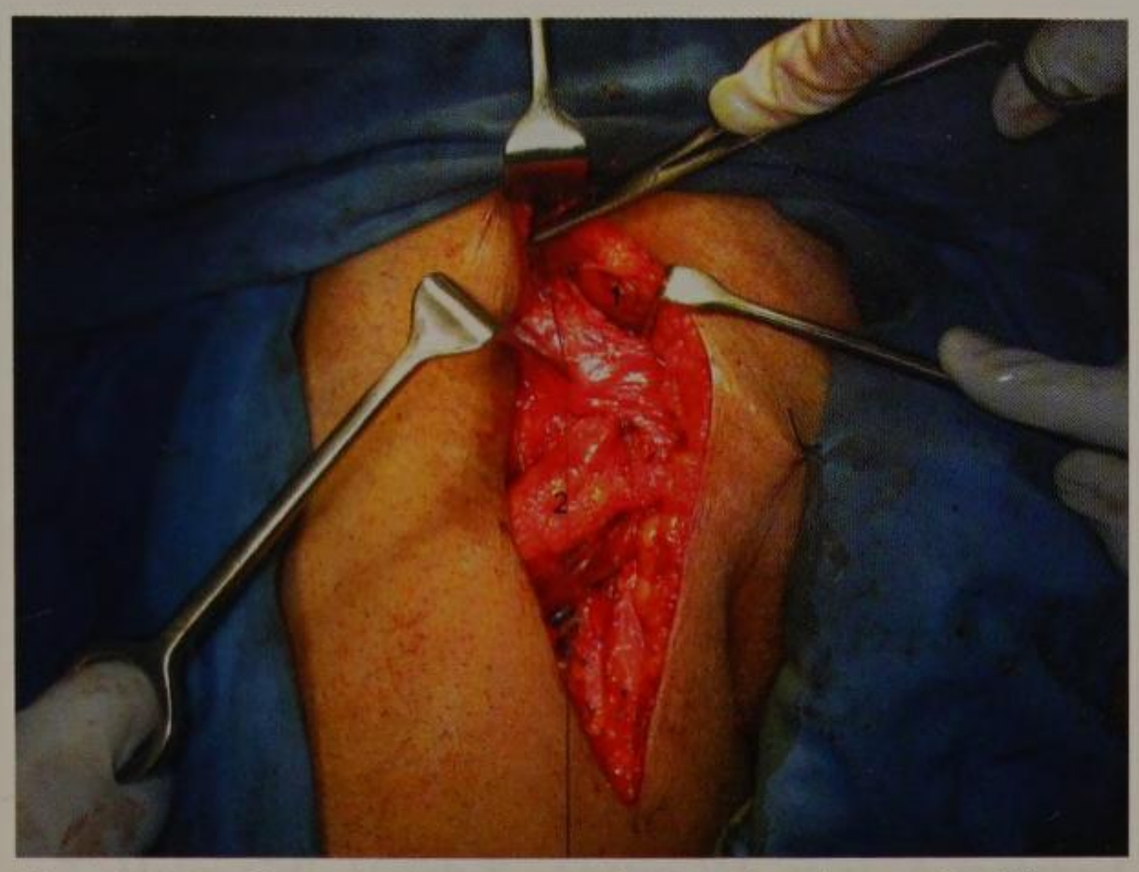

Fig. 20.20: Sartorius transposed; suturing internal oblique muscle
1. Internal oblique muscle
2. Sartorius

Fig. 20.19: Sartorius is being sutured to lower part of external oblique aponeurosis
1. Sartorius muscle 2. Femoral vessels
3. Adductor longus

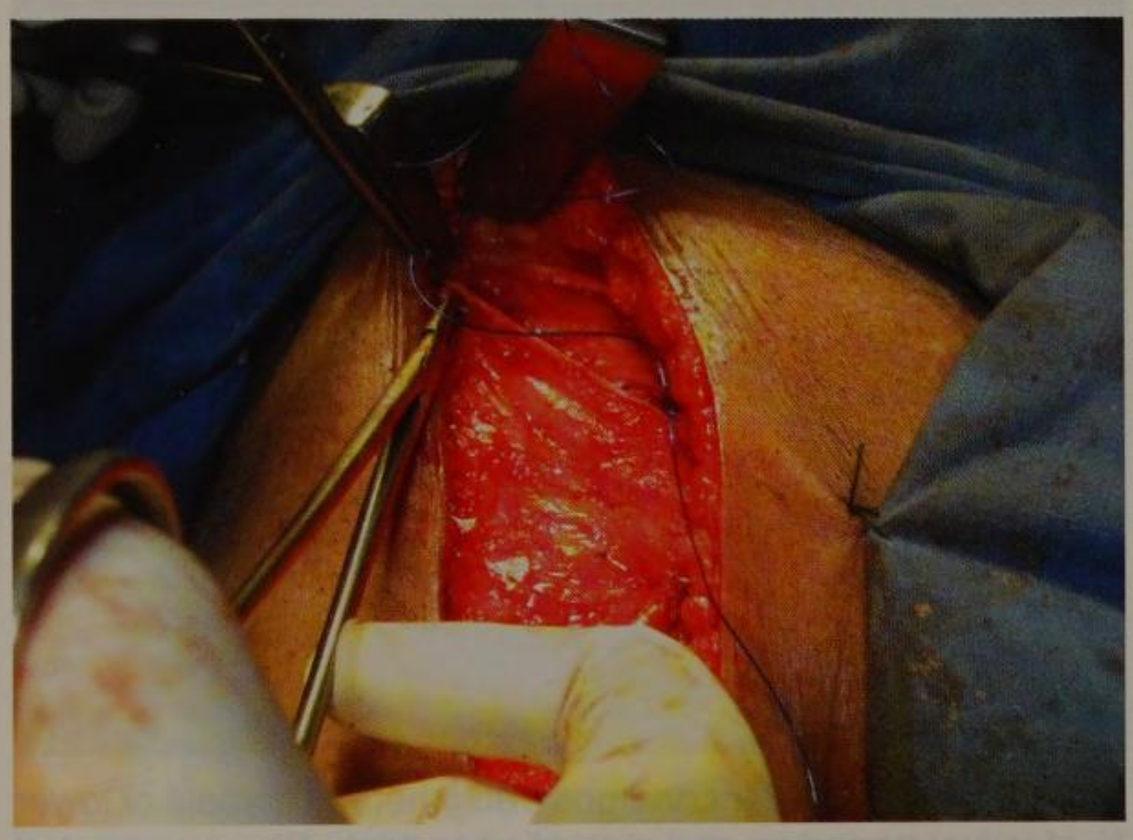

Fig. 20.21: Suturing external oblique aponeurosis. No 1/1-0 proline can be used

3. If symptomatic, lymphocyst can be surgically excised or drains can be inserted into it. Sclerotherapy with betadine can also be done.
4. Wound infection occurs in 10% of patients and anti-staphylococcal coverage is important.
5. Synergistic gangrene especially in case of single incision.
6. Other early complications include urinary tract infection, temporary anaesthesia of anterior thigh due to femoral nerve injury, thrombophlebitis and rarely pulmonary embolism.

Chronic Complications

1. Lymph edema occurs in 20% of patients.
2. Recurrent lymphangitis and cellulitis can also occur.
3. Femoral hernia can be prevented by suturing the inguinal ligament to Coopers ligament.
4. Genital prolapse.
5. Stress urinary incontinence.
6. Introital stenosis.

Fig. 20.22: Incision before closure. Subcutaneous vicryl sutures are placed before a subcuticular skin closure

Fig. 20.23: This patient had post radiotherapy fibrosis of lower ½ of vulva, perineum and extending to thigh. She was treated for carcinoma endometrium 15 years back, had a slipping of the brachytherapy source, sloughing of the area, which healed after repeated debridement. Patient was diabetic for 15 years
1. Ulceration 2. Condyloma
3. Cystocele

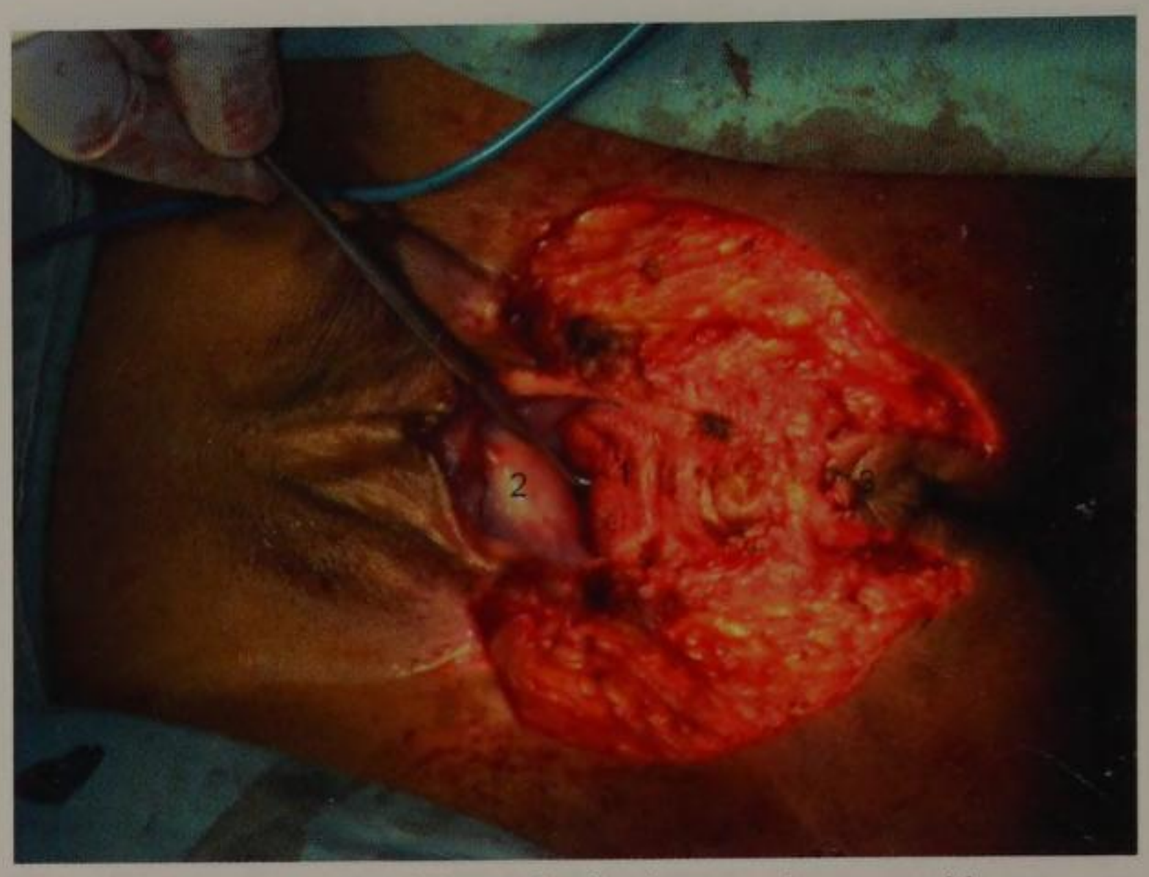

Fig. 20.24: After excision of all abnormal area with ulceration and condylomatas
1. Cut margins of vagina
2. Cystocele corrected by Stamey's suspension
3. Anal margins

Fig. 20.25: Gracilis myocutaneous flap marked to cover the defect

CONCLUSIONS

No other gynecological cancer has undergone as much change in management as vulvar cancer. The amin cause of failure in treatment of carcinoma vulva is inability to control lymphatic and distant metastasis. Lymphatic spread occurs in 30-40% of carcinoma vulva, primarily to inguinal lymph nodes. In node negative patients clearance of tumor bearing area and thus control of local disease dictates the outcome. When a prophylactic lymphadenectomy is contemplated an understanding of topography of inguinal nodes helps in carrying out an 'adequate clearance'.

Better understanding of oncologic principles led to the evolvement of more conservative surgery which include wide local excision, radical wide excision, modified radical surgery, vulval-sparing surgery. Limiting the inguinal node dissection to one side in early

cancers, using a triple incision technique instead of enbloc dissection to improve wound healing, sparing of the saphenous vein to prevent lymphedema, elimination of routine pelvic lymphadenectomy are some aspects of less mutilating surgery practiced today. Sentinel node dissection may eventually replace groin dissection. The use preoperative radiotherapy to avoid exenteration in patients with advanced disease and to decrease the incidence of groin recurrence in patients multiple positive groin nodes are other advances in management.

Key Points

1. All patients with stromal invasion more than 1 mm need inguino-femoral lymphadenectomy.
2. In lateralized lesions with negative ipsilateral lymph nodes the incidence of involved contralateral lymph node is < 1% in patients with early stage disease and unilateral lymphadenectomy is done.
3. If bulky ipsilateral lymph nodes are present or multiple microscopic ipsilateral lymph nodes are positive, contralateral groin dissection should be done.
4. In mid line lesions bilateral groin dissection should be done.
5. Pelvic lymphadenectomy should be done if > 3 groin nodes are pathologically positive or pelvic lymph nodes are clinically bulky.
6. Technique of radical hysterectomy described in detail.
7. Attention should be paid to appropriate post operative care to avoid complications. However, early and late complications are expected to occur with radical vulvectomy and can be treated as they arise.

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21

Vestibulectomy for Vulvodynia

Rachna Agarwal, Pushpanjali Rai

The International Society for the Study of Vulvovaginal Disease[1] (ISSVD) defines vulvodynia as chronic vulvar discomfort or pain, characterized by burning, stinging, irritation or rawness of the female genitalia in cases in which there is no infection or skin disease of the vulva or vagina causing these symptoms. Burning sensations are the most common, but the type and severity of symptoms may be highly individualized. Pain may be constant or intermittent, localized or diffuse.

Vulvodynia has been classified according to the pain characteristics into the following subtypes (ISSVD)[1]: Dysesthetic Vulvodynia (DV) and Vulvar Vestibulitis Syndrome (VVS).

Dysesthetic Vulvodynia (DV)

Dysesthetic vulvodynia is defined as vulvar burning, rawness, and irritation without known cause.[1] The pain is generally non-provoked i.e., there is pain without any contact.[1] It is usually generalized to the entire vulva, but sometimes can be located to one area (e.g. pain of the clitoris called clitorodynia). The cause of this disorder is unknown. Most experts believe that the pain of dysesthetic vulvodynia is caused by a combination of **nerve damage (with central sensitization) and pelvic floor muscle dysfunction**.

1. *Nerve damage*: The sensation of burning is generally equated with neuropathic pain (nerve pain). Back problems, allergic reactions, trauma, stretching the nerve or persistent infections are thought to be responsible for nerve damage.[2] However, infection is almost always overemphasized as a cause of nerve damage.
2. *Central sensitization*: There are pain nerve centres in the pelvis, spine, lower parts of the brain and the cortex (higher parts) of the brain[2]. When these pain centres get persistent signals, they get more sensitive, so almost all sensations are then perceived as pain. This is a physiologic process and can be seen on PET scans. Women with central sensitization experience pain more readily. Lastly, stress and anxiety potentiates pain. The chemicals (called neuro-transmitters) that activate these pain centres are the same neurotransmitters that are increased during stress/anxiety.
3. *Pelvic muscle dysfunction*: The muscles of the pelvic floor become dysfunctional—too tight yet weak. There is an increase in muscle tone resulting in decreased blood flow through the muscles. A 10% increase in muscle tone decreases blood flow by 50%.[2] When there is decreased blood flow there is decreased oxygen, decreased glucose, decreased nutrients to the muscles, and the vulval tissue. As the tissue lactic acid levels build up, the muscles become tight and sensitive.

Treatment

All of the above components must be addressed to treat DV. Neuropathic pain is the most difficult to treat as the nerves heal very slowly. Several agents are, therefore, used to depress the sensitive nerves:

Tricyclic antidepressants[3]—Amitriptyline, nortriptyline and desipramine. Side effects such as sleepiness, dry mouth, constipation, palpitation etc., are common with these medications. Updike et al on cross sectional survey of practice pattern among clinicians with vulval pain syndrome found most commonly used treatment was tricyclic antidepressant.[4]

Neurontin (gabapentin)—An anti-seizure medication.
Usually, a combination of two or more medications is required for effective control of symptoms. A combination of neurontin, an anti-inflammatory and topical lidocaine has proven to be an excellent combination.[2]

It is essential that the *pelvic floor dysfunction* is also addressed. A combination of *biofeedback and physical therapy* often works the best. In biofeedback, a machine with vaginal sensors measures the activity of the pelvic floor muscles.[2] By using the biofeedback machine a woman is able to train the involuntary muscles of the pelvic floor to relax. There are several different types of physical therapies including reflexology, cranio-sacral therapy and myofascial release, and trigger point muscle *massage*. All of these modalities are helpful in relaxing overly tight and tender muscles of the pelvic floor.

Fig. 21.1: Vestibule-area of vulva bound anteriorly by clitoris (black arrow) posteriorly by fourchette (white arrow) laterally by Hart's line

VULVAR VESTIBULITIS SYNDROME (VVS)

Vulval vestibulitis syndrome is the most common pathology in women with sexual pain. The prevalence of vulval vestibulitis varied from 2.9% to 9.8% depending on the stringency of diagnostic criteria and methods of ascertaining pain.[5]

The condition was first described by Skene in 1889 as an excessive sensitivity of the vulva and termed as 'vulvar hyperaesthesia.'[6] The condition was then ignored in the literature for almost 100 years. Woodruff described a similar condition in 1983 and attributed it to infection of the vestibular glands and proposed a purely surgical approach to the problem.[7] The condition was finally defined and given the name 'vulvar vestibulitis syndrome' (VVS) in 1987 by Friedrich.[8]

The three criteria to make a diagnosis of VVS (Friedrich) are:[9]

1. Severe pain on vestibular touch or attempted entry.
2. Tenderness localized to the vulva.
3. Physical findings confined to vulvar erythema of varying degree. It can be minimal and focal.

Fig. 21.2: Hart's line (marked by blue ink and arrows)

Anatomical Aspects

The vestibule (Fig. 21.1) is the area of the vulva bound anteriorly by the clitoris, posteriorly by the fourchette and laterally by Hart's line (the mucokeratinous junction on the medial aspect of the labia minora) (Fig. 21.2). Embryologically, the vestibule is the only part of the vulva that is endodermal in origin. As the bladder mucosa and the vulvar vestibule are both derived from the urogenital sinus, this could explain why patients with vestibulitis may have associated bladder symptoms. The minor vestibular glands are confined to a narrow segment of skin located at the base of the hymen. In contrast to the major vestibular glands (e.g. Bartholin glands) whose main function is providing lubrication for sexual intercourse, the function of the minor vestibular glands is unknown. Even though their anatomical distribution is confined exactly to the area of tenderness found in VVS, their role in the aetiology of this condition is still uncertain.[2,9]

Pathology and Etiology

Pathology and etiology is presently unknown. Racial differences appear to be important as rarely seen in women of Negroid race.[9] Until recently, many physicians believed that VVS is a consequence of human papillomavirus (HPV) infection and recurrent vulvovaginal candidiasis.[10,11] Using polymerase chain reaction (PCR) amplification to detect HPV DNA, Morin and co-workers (2000) showed, however, that HPV is not more common in women with VVS.[12] Bergeron et al and Bornstein et al have also questioned the assumption that women with VVS have HPV or chronic Candidal infection respectively and to both of them it appeared that VVS is not a consequence of chronic infection of HPV or candida.[13,14]

Halperin et al in 2005 compared 24 specimens of vestibulectomy for VVS with 16 control specimen and studied histopathologic characteristics in vestibular mucosa. The only histopathologic feature differentiating VVS from control group was the proliferation of peripheral nerve bundles found in 19 out of 24 specimens and none of the control group.[15] Their study showed that some women with VVS have ten times the area of nerve fibres within their vestibular mucosa. These nerve fibres called nociceptors are extremely pain sensitive. Therefore, even very light touch is extremely painful. A noxious stimulus to the nerve endings in the affected area (either by an infective agent such as Candida, trauma etc) results in the hypersensitivity of the nerve endings as evident clinically. Interestingly, Pukal et al (2005) on comparison of 14 women of VVS with controls have found that VVS patients had significantly higher activation levels in insular and frontal cortical regions than did controls suggestive of central sensitization as in cases of DV.[16]

Symptomatology

The condition is diagnosed on the basis of Friedrich criteria as described above.[8] The condition results in a hyperaesthesia of the vulvar vestibule, particularly at the base of the hymenal remnant (around the opening of the minor vestibular glands) and extending anteriorly to the paraurethral gland areas, and even sub-clitorally. Burning sensations are usually the most common symptom and may be experienced with some or all of the following: sexual intercourse, tampon insertion, gynaecological examination, bicycle riding, and wearing tight pants.[2]

Diagnosis

Positive Q-tip test[2]—In VVS, there is pinpoint tenderness in the area of the minor vestibular glands and this can be easily evaluated by the gentle application of a cotton-tipped applicator (Fig. 21.3). The tenderness is precisely confined to the base of the hymen, often focal and sometimes involving the paraurethral tissues and occasionally can extend to the area between the urethra and clitoris. Application of the cotton tip several millimetres away elicits no tenderness at all. The area around the openings of the Bartholin glands is often the site at which the symptoms start. Erythema is usually present although this can be minimal and not readily appreciated.[2]

TREATMENT FOR VVS

A careful history is taken. The vulva examined with cotton tipped applicator to map out areas of tenderness (Fig. 21.4) and skin scrapings taken for culture on Sabauraud medium for possible Candida infection. All patients are subjected to colposcopic assessment of the vulva after application of 5% acetic acid. A biopsy is taken if there are abnormal colposcopic features suggestive of associated pathology.

Earlier studies used measures include reassurance, local analgesic agents, eradication of chronic candidiasis and use of membrane stabilizing agents such as amitriptyline.[10] Other used estrogens, atropine and

Fig. 21.3: Q-tip test-gentle application of a cotton-tipped applicator to elicit pain in vulvodynia

Fig. 21.4: Pain mapping in vulvadynia, cotton tip is used to test the pain at 2°, 4°, 6°, 8° clock position the vestibule

nitroglycerine cream, injected or topical steroid, interferon or laser therapy to treat generalized or localized vulvodynia.[17,18] Vestibulectomy was only used for generalized vulvodynia refractory to above measures.

Earlier surgery was used "only as a last resort" with risk of complications such as scaring and recurrence being used to justify such cautionary statements.[2,19,20] However, presently studies have shown apparently high success and satisfactory results after vestibulectomy or simple modified posterior vestibulectomy.[2,21] Other modalities available for VVS are electromyographic (EMG) biofeedback and cognitive-behaviour therapy. Bergeron et al performed the first randomized controlled trial. He found that though biofeedback and group cognitive-behaviour offered some improvement in symptoms but women often had better outcome after vestibulectomy than either EMG or cognitive-behaviour group.[21] Hence, even if vulvodynia resolves, the psychologic and sexual dysfunction persists. A multidisciplinary approach is advocated to treat the psychologic impact of chronic pain involving physician, sex therapist, psychologist to treat biologic, psychologic and social aspects of vulvodynia.

Surgery

Surgical excision of the medial aspect of vulvar vestibule (including the hymenal remnants) and vaginal advancement was first described by Woodruff in 1981.[7] Contrary to the previous reports of surgery being a last rescue effort, current experience with vestibulectomy[21-23] or modified vestibulectomy[24,25] procedures has shown satisfactory results and high cure rates.

Vestibulectomy is the surgical removal of the mucosa of the vestibule. Bornstein et al on meta analysis of the published literature on vestibulectomy (1991-1998) found complete resolution of pain in 72% and partial relief in as high as 89% cases with this procedure.[20] Gaunt et al on retrospective analysis of 42 patients who had vestibulectomy from 1992-2001 found 90%[38] with "pure VVS" had significant improvement ($p < 0.01$) in there symptoms (Wilcoxan signed—rank test evaluated change in symptoms scores).[22] In another study on 104 women with VVS, Goldstein et al found 93% of patients were satisfied or very satisfied with outcome of their surgery.[23] Prior to surgery 72% of women were completely apareunic; however, after surgery only 11% were unable to have intercourse.[23]

Simple modified vestibulectomy (SMPV) is resection of the hypersensitive mucosa under local anaesthesia using the hymen fold as a flap, avoiding vaginal advancement.[24,25] This approach for VVS is considerably less invasive, technically simpler and probably less time consuming.

Mark on study of 27 patients with vulval vestibulitis limited to posterior vestibule treated with modified vestibulectomy found only 52% with immediate complete response while 19%[5] had no response and 30%[8] recurred on follow-up of 2 years.[26] Kehoe and Duesley evaluated the success of a modified vestibulectomy in treating vulvar vestibulitis in 57 patients with follow-up of 1 year. They found complete response in 33 (61.1%) of women, partial response in 15 (27.8%) and 6 had persistent symptoms.[24] Lavy on the other hand treated 59 patients of vulval vestibulitis with simple modified vestibulectomy and found 73.6%[39] with complete response on follow-up of 6 months to 10 years postoperative results employing this procedure were found to be in line with other surgical methods that are more extensive.[25]

Surgical Procedure

Pre-requisites before Surgery

1. Selection of proper surgical candidate.
2. Treatment of vaginismus if present with vaginal dilators or physical therapy.
3. Sexual and psychologic counselling is indispensable to treat the associated psychosexual and relationship dysfunction.

Steps of Total Vestibulectomy[2]

Vestibulectomy is most often performed under spinal or general anaesthesia. Pain mapping with a cotton swab should be done before anaesthesia while in the operating room (Fig. 21.4). Often pain may be in the majority of the vestibule. The incision may need to approach the periurethral area, and extend from the opening of Skene's ducts to the perineum. Excision of the periurethral area should occur with caution not to compromise the angle of the urethra. The incision is carried down laterally along Hart's line to the superior portion of the perineum (Fig. 21.5). The incision should extend above the hymenal ring. The intervening skin, mucous membrane, hymen, and adjacent tissue are removed. The tissue is removed to a depth of 2-5 mm (Fig. 21.6). The minor vestibule glands are excised and Bartholin's ducts are transversed in the dissection (however, it is rare to see a cyst develop after vestibulectomy. The vagina is undermined, mobilized, and brought down to cover the defect (Fig. 21.7). The defect should be closed in 2 layers using absorbable 3-0 and 4-0 sutures (Fig. 21.8).

Complications

Complications in vestibulectomy include bleeding, wound infection or separation, granulation tissue, chronic fissuring, scarring. Bartholinitis is an uncommon occurrence reported in 14 patients of partial vestibulectomy by Peters.[27]

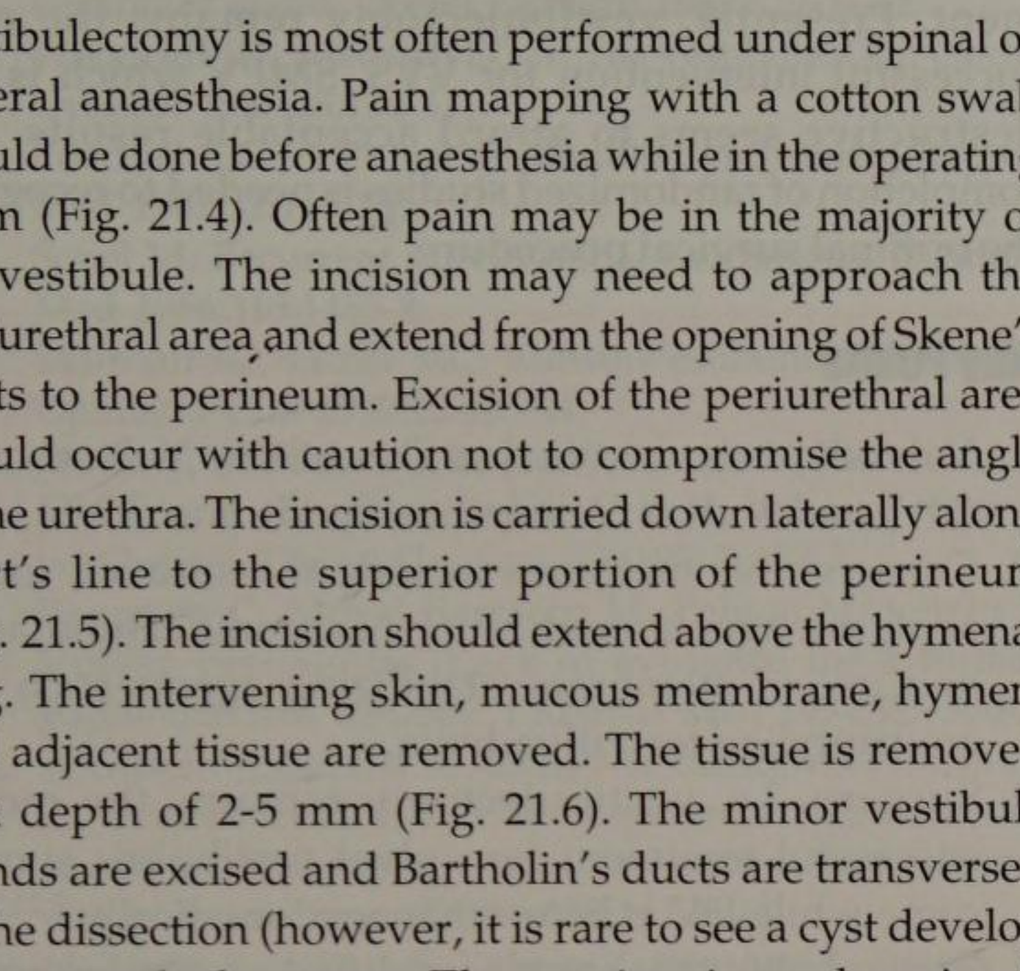

Fig. 21.5: Line of incision for vestibulectomy avoiding the periurethral area (no pain Q-tip test in this region)

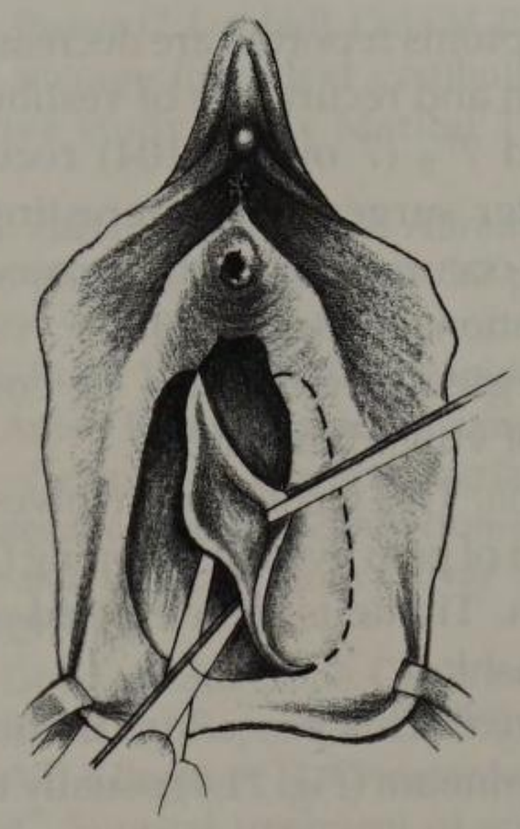

Fig. 21.6: Vestibulectomy dissection along the Hart's line and tissue removed (2-5 mm depth)

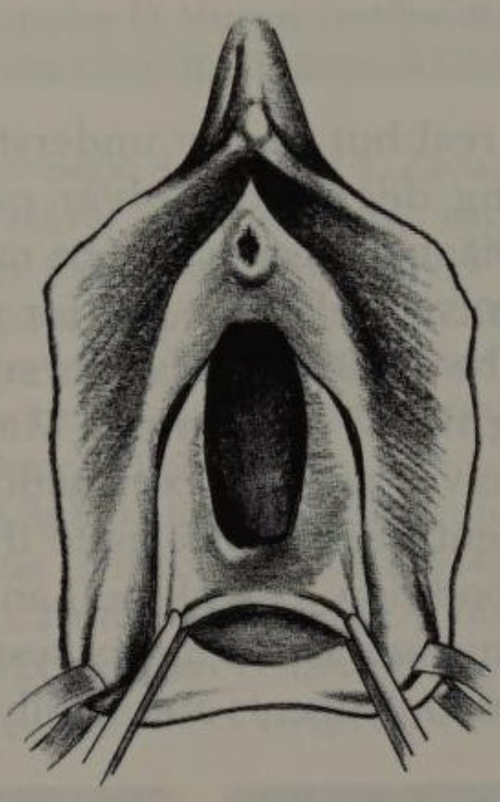

Fig. 21.7: Vaginal flap raised to cover the defect after removal of the vestibular and hymen tissue

Fig. 21.8: Vaginal flap opposed to vulval tissues by an absorbable continuous (unlocked) sutures

Other symptoms reported are decrease in lubrication, continued pain and recurrence of vestibulitis. Goldstein et al reported 7% (7 out of 104) recurrence of any symptoms after surgery.[2, 3] Interestingly, the risk of complications occurring with this procedure is low and most complications are transient.

Other surgical techniques to correct introital dyspareunia of vulvodynia are:

1. *Local excision:* This technique involves localization of precise area of pain by pain mapping (Fig. 21.4) before anaesthesia. Tissue is then excised an closed in an elliptical fashion.
2. *Perineoplasty:*[28] This procedure involves removal of tissue of perineum (Fig. 21.9) usually terminating just above the anal orifice. Vaginal mucosal flap is raised and advanced to cover the defect.

CONCLUSIONS

VVS is a very real but poorly understood condition causing varying degree of vulvar pain and entry dyspareunia. Diagnosis can easily be made by careful inspection of vulva and Q-tip test for pain mapping. Patient should be assured that she is suffering from a definite recognized syndrome. Management of vulvodynia involves a careful explanation of the condition to the patient, reassurance as to the self-limiting nature of the condition. Use of local analgesic agents, eradication of any candidiasis, use of systemic neuronal membrane stabilizing agents and finally for refractory cases, surgical vestibulectomy with vaginal advancement. Presently, vestibulectomy remains the most successful intervention for VVS. SMPV which is less destructive seems to afford acceptable results. The completion of randomized studies is needed to recognize the optimal surgical procedure.

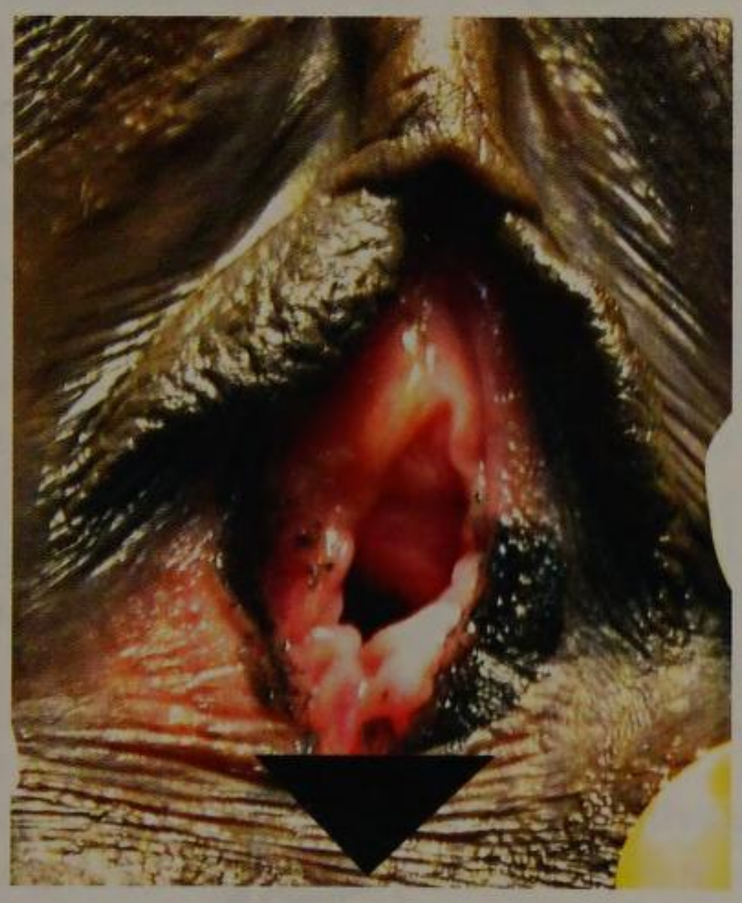

Fig. 21.9: Inverted triangle (black shading) shows the portion of perineum to be excised alongwith vestibulectomy (if pain present at perineum) for perineoplasty

Key Points

1. Vulvodynia is classified as Dysesthetic Vulvodynia (DV) and Vulvar Vestibulitis Syndrome (VVS).
2. Conservative measures include reassurance, local analgesic agents, eradication of chronic candidiasis and use of membrane stabilizing agents such as amitriptyline for vulvodynia.
3. Surgery, i.e. vestibulectomy remains the most successful treatment for vulval vestibulitis syndrome while DV is better managed medically.[2,21,22]
4. Earlier belief that simple modified vestibulectomy (SMV) produces only a modest likelihood of relieving symptoms of posterior vulvar vestibulitis is controversial. Later studies have shown SMV to be considerably less invasive, technically simpler and probably less time consuming with affordable results.[25]
5. More randomized studies are needed to recognize the optimum surgical procedure.
6. Vestibulectomy only treats the biologic process of vulval pain in vulvodynia. Psychosexual counselling is mandatory to adequately treat the social aspect of vulval pain.

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Section V

Vaginal Surgery for Prolapse and Reconstructive Vaginal Surgery

22 Current Concepts of Pelvic Organ Prolapse: Evaluation and Choice of Procedure

KC Singh, SD Barman

Pelvic organ prolapse (POP) is a dysfunction of pelvic support, which affects quality of life of a woman both physically and emotionally. Clinically, POP is readily apparent but the understanding of this disorder is still not very clear. Concept of POP has been changing as a result of increased understanding and appreciation of the contributions of various tissues to support pelvic organs.

The support of pelvic organs is not static but a *dynamic* one and it gets constantly adjusted to the changes in intra-abdominal pressure that occurs in variety of activities. It is clear that dynamic support can only be provided by the pelvic floor muscles through their activity that constantly adjusts in response to changing circumstances.[1,2] Muscular weakness is mostly acquired during childbirth by denervation damage rather than structural tear of muscle fibre. The degree of nerve damage is not affected by forceps delivery and perineal tears. Cesarean delivery during active labor and vaginal delivery have a similar effect on the maternal pelvic support suggesting that pelvic floor damage occurs in the first and not the second stage of labor.

Pelvic organs are optimally supported when they are in their normal position and the role of pelvic ligaments and endopelvic fascia is primarily to maintain this normal position. Weakness of ligaments occurs in connective tissue abnormalities, which can be congenital, or due to childbirth trauma. Fibroblasts grown in tissue culture obtained from fascia of women with prolapse have more of weaker type III collagen. Connective tissue undergoes constant turnover and remodeling in response to stress, and this process is affected by hormonal changes that occur during pregnancy and parturition, as well as aging through their effects on collagen. Thus, during menopause, weakness of pelvic support manifests for the first time or becomes more pronounced. It appears that the use of HRT in post-menopausal women reverses some of the changes observed in cases of prolapse.[3]

Evaluation should use standardized terminology and classification of this condition as developed by the International Continence Society[4] for worldwide acceptance. The terms, prolapse of anterior vaginal wall, posterior vaginal wall, prolapse of cervix or vault should replace cystocele, rectocele, uterine prolapse, and enterocele. Hymen instead of introitus is taken as the fixed point of reference for measuring the degree of prolapse. According to the maximum protrusion of the leading part, the following stages of POP are classified (Table 22.1).

Table 22.1: Stages of POP by Pelvic Organ Prolapse Quantification (POP-Q) System[5]

Stage 0	No prolapse is demonstrated. Apex (Cervix or vault) is between – 2 cm of total length of vagina [(TVL-2)].
Stage I	Leading point of the prolapse does not descend below 1 cm above hymenal ring. It can be I-C if the cervix is the leading point, I-Ba or I-Bp if the leading point is upper anterior wall or upper posterior wall respectively.
Stage II	Leading point of the prolapse is ±1 cm of plane of the hymen. It can be II-C, II-Bp, etc.
Stage III	Leading point of the prolapse is > 1 cm below the plane of the hymen but the total vaginal length is 2 cm. It can be III-C, III-Bp, etc.
Stage IV	The vagina is completely everted. The leading edge of will be the cervix or vaginal cuff scar. The total vaginal length is < 2 cm.

Aa, 3 cm proximal to hymen. Ba, most dependent position of the portion of the anterior vaginal wall above Aa.

Ap, 3 cm proximal to hymen. Bp, most dependent position of the portion of the posterior vaginal wall above Ap.

C, cervix or vaginal cuff scar; D, posterior fornix.

Concepts of Surgical Management

Surgery is the mainstay of treatment and its aim is restoration of absolute well being that includes sexual function rather than simply correcting the anatomical defect. However, it should be considered when patients' symptoms are bothersome enough that they wish to accept the risks, inconveniences and complications that may associate with the procedure. Important consideration is that there may be differences between patient and gynaecologist's perceptions of need for treatment and its outcome. Therefore, it is important to understand woman's goals for treatment. Surgery can restore vaginal anatomy and relieve symptoms in many women who opt for surgical repair. However, improvement in objectively measured outcomes after surgery does not always correspond to patient satisfaction.

The vaginal route is unique to gynecologic surgeons and offers the advantages of a quick recovery and few complications. Most of the gynaecologists would, therefore, consider vaginal approach at the outset. However, to be successful, it needs to strengthen the pelvic support based on the knowledge of various components of pelvic organ support. We know that ligaments and fascia cannot return to the original form once they are stretched beyond the limit. They need to be shortened by plication or supported by mesh. Sagging of levator plate resulting from muscular weakness has to be corrected because this defect widens the urogenital hiatus and changes the normal horizontal axis of the vagina to a more nearly vertical axis. Secondly, under normal circumstances, both rectum and vagina are pulled towards the pubic bones by puborectalis muscle that arises from pubic bone and directly inserts onto the pelvic viscera and the lumens are constricted when this muscle contracts. It is this contractile property that is so important in maintaining the continence and providing support for the genital organs.

Thus, the principles of surgery are to (1) plicate pubovisceral (puborectalis) muscles in order to decrease the genital hiatus (2) repair fascial defects by plicating endopelvic fascia and ligaments (3) strengthen levator plate either by plication and/or fixing vault to the spine or sacrum. This procedure will correct the vaginal axis as well.[3] Use mesh or graft to strengthen the ligaments/fascia. Type I or macroporous synthetic mesh is widely used and it has the advantage of being readily available, cost-effective, and consistent in quality, but may present with significant complications, including infection and erosion. During mesh insertion, one should be careful about overcorrection and it should never be inserted under tension because all meshes contract to certain extent, maybe upto 20%. Mesh erosion is one of the complications leading to failure of the procedure. Category I evidence (Cochrane database[6]) revealed that for the anterior vaginal wall prolapse, standard anterior repair was associated with more recurrent cystocele than when supplemented by Vicryl mesh overlay (RR 1.39, 95% CI 1.02 to 1.90) but data on morbidity and other clinical outcomes were too few for reliable comparisons.

Surgery for Various Components of POP

Anterior Vaginal Wall Prolapse

Traditionally anterior colporrhaphy is performed to repair anterior vaginal wall prolapse. The essentials of the procedure are to reduce the prolapse and repair the fascial (pubovesicocervical fascia) defect by plication. Recent trend is to use a mesh to supplement the repair and it is essential in those patients with large facial defect to prevent recurrence. Tension-free vaginal tape is recommended in situations where there is accompanying stress incontinence (see Chapter 23).

Posterior Vaginal Wall Prolapse

The conventional posterior colporrhaphy includes repair of both rectocele and enterocele vaginally. The principal aim is to strengthen the pubovisceral portion of levator ani muscles. As in repair of anterior vaginal wall prolapse, use of mesh is recommended in addition to plication of the pubococcygeous muscles. Care must be taken not to cause narrowing of vaginal introitus to prevent subsequent dyspareunia (see Chapter 24).

Apical Prolapse

Traditional procedure is vaginal hysterectomy with pelvic floor repair (anterior colporrhaphy and posterior colpoperinorrhaphy). However, in advanced prolapse (stage III onwards), plication of levator ani muscles is not enough to elevate the sagging levator plate and it requires additional support in the form of colpopexy/uteropexy to sacrum or sacrospinous ligament. These procedures can be performed both vaginally (sacrospinous colpopexy) and abdominally (sacrocolpopexy) (see Chapter 27).

Both the procedures are highly effective in the treatment of apical prolapse and significantly improve the patient's quality of life[7]. The removal of uterus is not mandatory for the correction of the disorder and comparable success rates have been reported between

sacrospinous cervicocolpopexy with uterine conservation or vaginal hysterectomy concomitant with sacrospinous colpopexy[1,4]. However, Roovers JP, et al (2004)[8] in a randomized trial consisting of eighty-two patients undergoing surgical correction of uterine prolapse stages II-IV suggested that vaginal hysterectomy with anterior and/or posterior colporrhaphy was preferable to abdominal sacro-colpopexy with preservation of the uterus in terms of discomfort of prolapse and micturition symptoms measured before and six weeks, six months and one year after surgery.

In post hysterectomy apical prolapse abdominal sacrocolpopexy with mesh remains the 'gold standard.' Cochrane database (2004)[6] identified fourteen randomized controlled trials evaluating 1004 women to determine the effects of surgery in the management of pelvic organ prolapse. Abdominal sacral colpopexy was better than vaginal sacrospinous colpopexy in terms of a lower rate of recurrent vault prolapse (RR 0.23, 95% CI 0.07 to 0.77) and less dyspareunia (RR 0.39, 95% CI 0.18 to 0.86), but the trend towards a lower re-operation rate for prolapse following abdominal sacrocolpopexy was not statistically significant (RR 0.46, 95% CI 0.19 to 1.11). However, the vaginal sacrospinous colpopexy was quicker and cheaper to perform and women had an earlier return to activities of daily living. Carey and Slack[9] found transvaginal sacrospinous colpopexy procedure to be a useful adjuvant when treating marked utero-vaginal prolapse and in contrast to abdominal approach allowed the surgeon to correct coexistent cystocele and rectocele.

Women who do not desire future vaginal intercourse and/or are in poor general health may consider an obliterative procedure, such as colpocleisis (see Chapter 32). Such procedure is highly effective with low morbidity for correcting apical prolapse in such women. The other more radical procedure such as vaginectomy with pelvic herniorrhaphy was advocated by some authors. It may be suitable in high risk elderly patients where morbidity is of much concern.

Laparoscopic Surgery

In recent years this form of surgery is gaining popularity because of many advantages including low morbidity. However, laparoscopic approach for the management of POP appears to be least utilized, because of the great degree of technical difficulty associated with laparoscopic suturing and has not gained widespread acceptance. Besides, plication of levator ani muscles, the main component of repair of pelvic relaxation cannot be performed through laparoscope. Nevertheless, few authors have advocated[9] the use of laparoscopic uterosacral ligament vault suspension and iliococcygeous and sacrospinous fixation because of its associated low morbidity. Thus as of today, this procedure should be reserved for those patients where only the colpo- or uteropexy is contemplated.

CONCLUSIONS

Pelvic organ prolapse (POP) is a dysfunction of pelvic support, which affects quality of life of a woman both physically and emotionally. Evaluation should use standardized terminology and classification of this condition as developed by the International Continence Society for worldwide acceptance. The terms, prolapse of anterior vaginal wall, posterior vaginal wall, prolapse of cervix or vault should replace cystocele, rectocele, uterine prolapse, and enterocele. Hymen instead of introitus is taken as the fixed point of reference for measuring the degree of prolapse.

Key Points

1. Surgery is the mainstay of treatment and its aim is restoration of absolute well being that includes sexual function rather than simply correcting the anatomical defect.
2. It is important to understand woman's goals for treatment.
3. The pubovisceral (puborectalis) muscles are plicated in order to decrease the genital hiatus.
4. Fascial defects are corrected by plicating endopelvic fascia and ligaments.
5. Levator plate is strengthened by bringing together the levator ani muscles/or fixing vault to the spine or sacrum. This procedure will correct the vaginal axis as well.
6. Mesh or graft is used to strengthen the ligaments/fascia.
7. Type I or macroporous synthetic mesh is widely used and it has the advantage of being readily available, cost-effective, and consistent in quality, but may present with significant complications, including infection erosion.
8. During mesh insertion, one should be careful about overcorrection and it should never be inserted under tension because all meshes contract upto 20%.

9. Category I evidence revealed that for the anterior vaginal wall prolapse, standard anterior repair was associated with more recurrent cystocele than when supplemented by Vicryl mesh overlay.

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23 Surgical Correction of Anterior Compartment Defects

Abha Sharma

Anterior vaginal wall defects are common; nearly half of all women seeking gynecological care have some degree of cystocoele. Fortunately most of these defects are asymptomatic.

The anterior compartment of vagina extends from pubic symphysis anteriorly to the posterior aspect of cervix. The lateral boundaries are the white lines or Arcus Tendineus Fascia Pelvis (ATFP), to which the paravaginal connective tissue attaches. The vaginal wall is composed of three layers: the mucosa, the muscularis and the adventitia. The mucosa is non-keratinising squamous epithelium overlying lamina propria. The muscularis consists of smooth muscles and small amounts of collagen and elastin. The adventitial layer is a variably discrete connective tissue layer of collagen and elastin between the muscular wall of vagina and the adjacent paravaginal connective tissue.[1] **Support of anterior vaginal wall depends on a continuous line of connective tissue support; transversally from white line to vaginal edge and to the other side white line. Anteroposteriorly it depends on paracolpium i.e., ligamentous attachment from pubic bone to apical uterosacral ligament complex.**

Defects of Anterior Vaginal Wall Support—Site Specific Defect Theory

For a long time assumption was made that during childbirth gradual attenuation and stretching of endopelvic fascial supports occurred, leading to prolapse. However with further research 'site specific defect theory' was forwarded by several researchers.[2,3] It is based on the premise that "**Tears in the endopelvic fascia surrounding the vaginal wall allow herniation of pelvic** *organs*"; therefore during surgical repairs these breaks should be identified and repaired individually.

Types and Identification of Defects in Anterior Vaginal Wall

Anterior vaginal wall prolapse can be of four types depending upon site of tears in fascia. These may occur singally or in combination[4,5] (Fig. 23.1).

Paravaginal/Lateral Defects

When paravaginal connective tissue gets detached from the arcus tendineus fascia pelvis, it leads to lateral defects. These are identified by the loss of lateral sulcus of vagina. Recreating the lateral vaginal sulcus by holding the vagina laterally against side walls with the help of forceps will lead to correction of defect. Another differentiating feature from central defect is that vaginal rouge are present. These are also known as displacement defects.[6] Paravaginal repair is the method of choice for correction of this type of defect (Fig. 23.2).

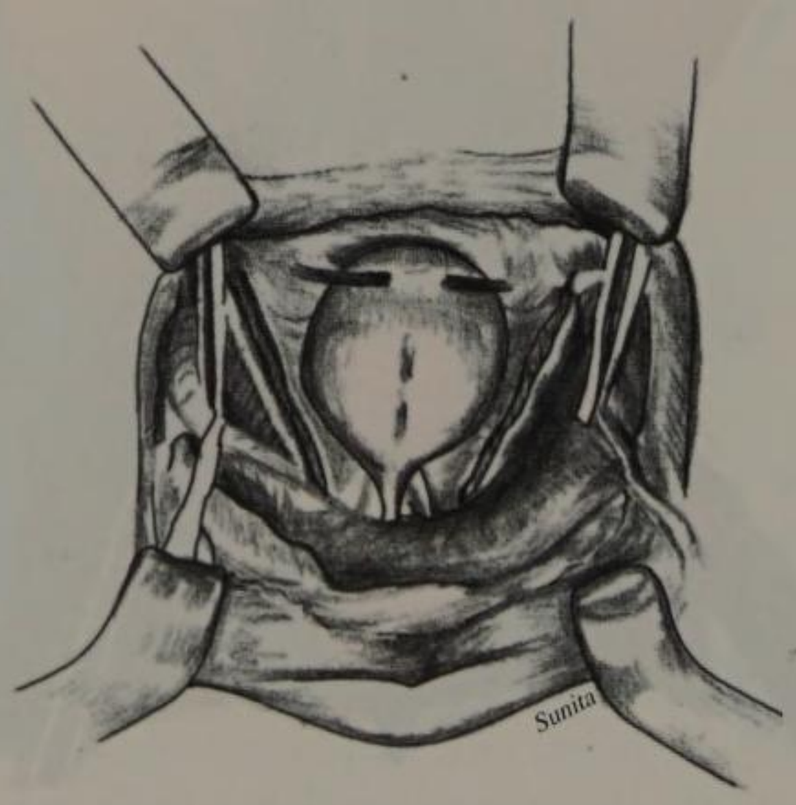


Fig. 23.1: Sites of fascial tears in anterior vaginal wall defects

Fig. 23.2: Cystocele

Central Defects

Central defects occur when there is defect in vaginal muscularis and mucosa of vaginal wall gets detached from muscularis. Rougae are absent. If side walls are held with forceps, central portion still bulges out. Midline defects are also known as distension defects. These should be repaired by anterior colporrhaphy (Fig. 23.3).

Transverse Apical Defects

These occur when vaginal muscularis gets detached from the pericervical ring of connective tissue in a patient with intact uterus. It can also occur in patients who have undergone hysterectomy when there is lack of continuity between anterior vaginal muscularis and posterior uterosacral ligament complex. These defects are identified when support to superior anterior vaginal wall only, corrects the defect. Also rugae may be lost over the dominant part of prolapse but may be present at distal anterior wall, representing the site where retracted muscularis layer may be found. These defects are repaired as apical prolapse by uterosacral ligament suspension or by abdominal sacro-colpopexy (Fig. 23.4).

As a Part of Procedentia/Apical Prolapse

When loss of support of uterus or vaginal cuff itself occurs the apex descends and drags the anterior wall along, creating anterior wall descent despite absent fascial tears. Supporting the vault during hysterectomy by plicating anterior vaginal wall muscularis with uterosacral ligament complex should prevent it. These defects are repaired by uterosacral ligament suspension or by abdominal sacral colpopexy.

However, it should be noted that the specific type of anterior wall defects can be difficult to diagnose preoperatively.[7] Therefore, restitution of all the normal attachments of support should be the goal of pelvic surgeon.

Another point to consider before surgical correction is the presence of stress urinary incontinence, which could be masked by the presence of huge cystocoele and resultant kinking of urethra. An easy way to test for this

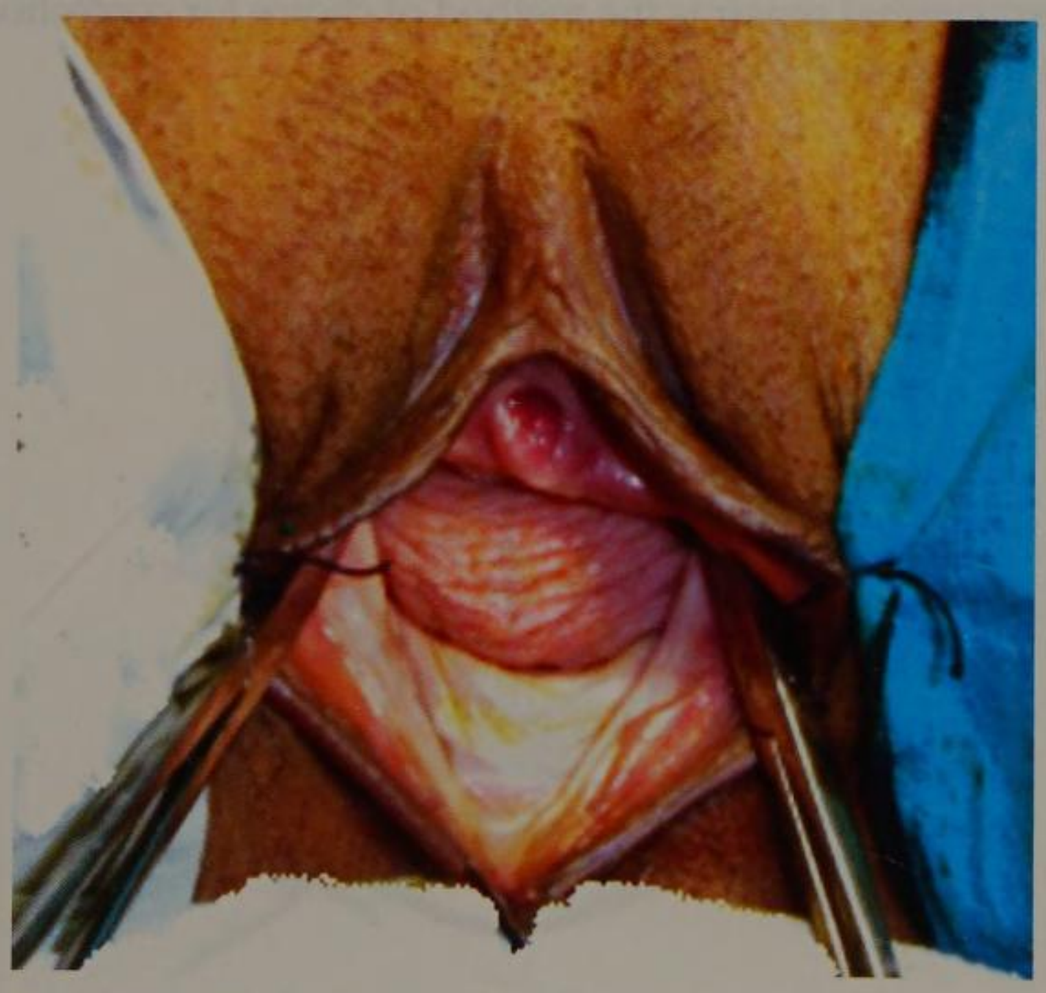


Fig. 23.3: Central defects—No correction of cystocele despite re-creating the lateral vaginal sulci

Fig. 23.4: Procedentia–Loss of support to uterus and vaginal apex dragging the anterior vaginal wall along

preoperatively, is to reduce the prolapse, support the anterior vaginal wall defect with pessary or speculum, this will straighten out urethra. Now patient is asked to strain/cough with full bladder. If urinary leakage is present, concomitant incontinence correction procedure should be planned.

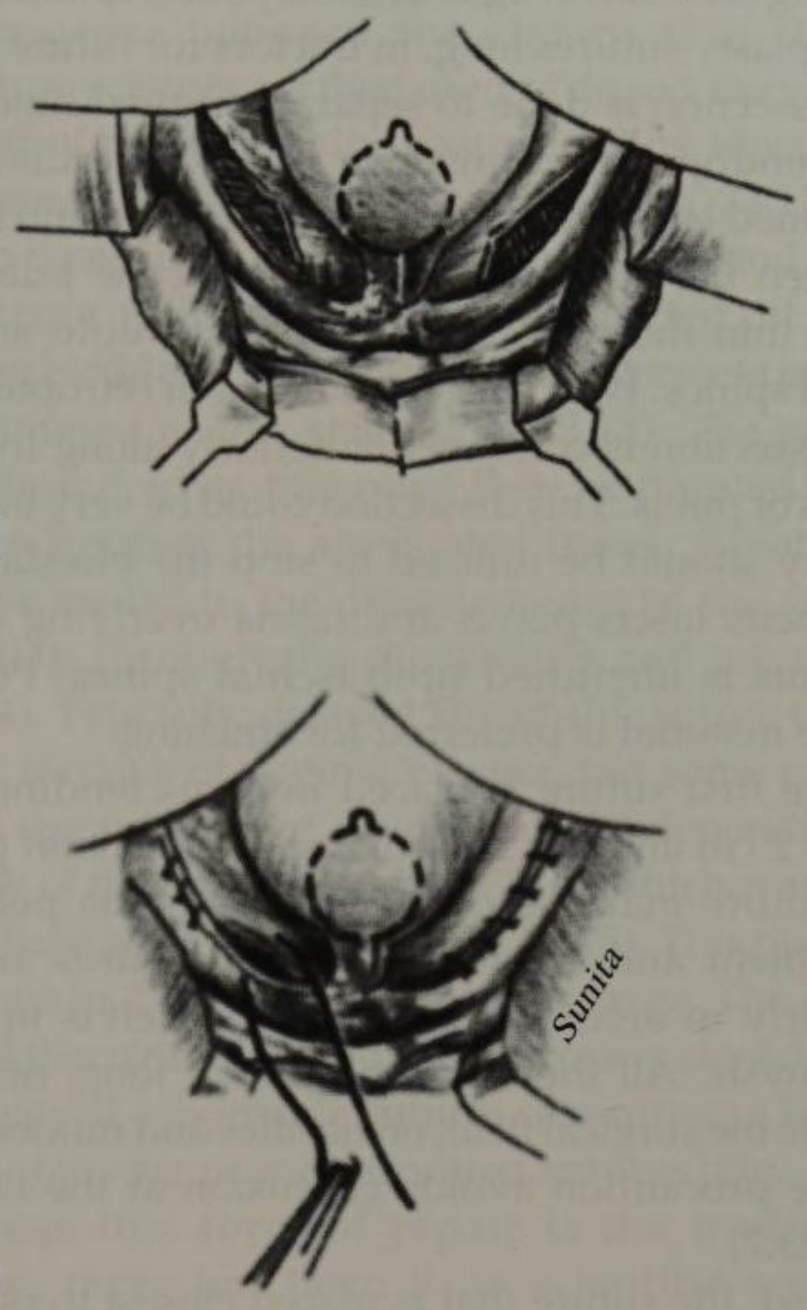
TECHNIQUE OF PARAVAGINAL REPAIR

Paravaginal repair aims to reattach the paravaginal connective tissue to arcus tendineus fascia pelvis, thus correcting lateral defects. It can be performed abdominally, vaginally or laparoscopically. For patients having an element of stress urinary incontinence, abdominal approach is the method of choice.

In abdominal approach,[3,4] patient is positioned to allow access to the vagina, preferably in operative stirrups. The retropubic space is entered either through open incision or laparoscopically. The bladder and vagina are depressed medially to visualize the area of paravaginal connective tissue attachment to lateral wall of vagina. The dissection in this space is done from inferior surface of pubic bone to ischial spines and arcus tendineus fascia pelvis is identified. If no edge of paravaginal connective tissue is identified, Surgeon should place their nondominant hand in vagina and elevate the lateral vagina to arcus tendineus fascia pelvis. A permanent suture like Braided polyester or polypropylene should be used for reattachment. The first stitch should be placed through near full thickness of vagina, at a level just distal to ischial spines and then through arcus tendineus fascia pelvis. The stitch is held untied, on long forceps. Further stitches are applied similarly upto pubic bone. Careful attention should be paid to obturator nerve and vessel bundle. Haemostasis should be meticulously ensured. After tying of all sutures,lateral sulcus of vagina should reform (Fig. 23.5).

In transvaginal repair; patient is laid in lithotomy position with legs in operative stirrups. Ideally the angles of hip and knee should be 90°. Lavage of the vagina to remove adherent bacteria should be included in part preparation procedure. The use of lighted speculums is strongly recommended as ensuring visibility by focusing the ceiling lights, deep near the lateral pelvic wall is very difficult.[5,8]

Before starting marking sutures are placed at the level of urethrovesical junction just lateral to lateral sulci. An anterior midline vaginal wall incision is given from immediately anterior to cervix/vaginal scar in hysterectomised patients, upto urethrovesical junction (Fig. 23.6). Hysterectomy, if required, is done now,



Figs 23.5A and B: Abdominal paravaginal repair: (A) Separation of fascia of lateral vagina from ATFP, (B) Lateral vaginal wall fascia is reattached to ATFP by sutures

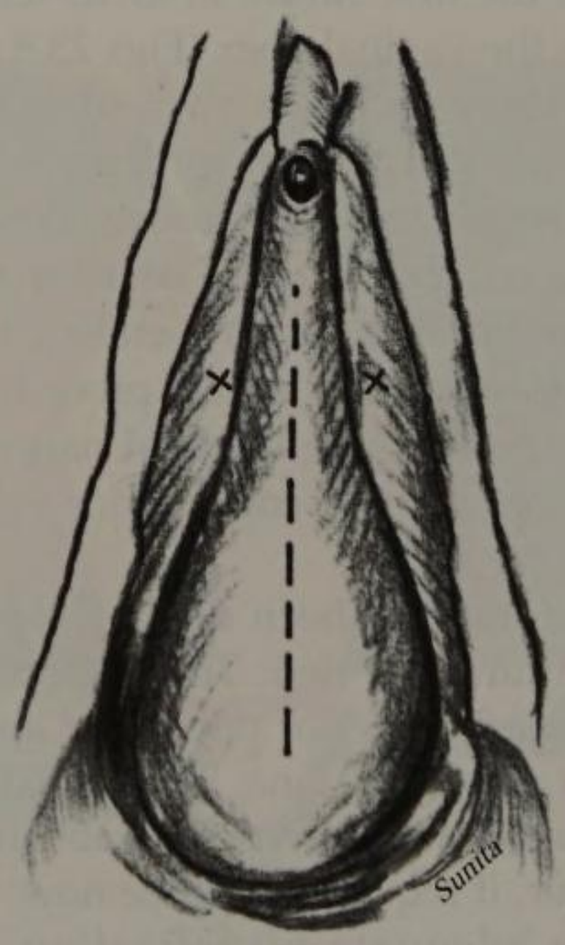


Fig. 23.6: Incision line for vaginal paravaginal repair. Marking sutures have been placed at urethrovesical junction

keeping uterosacral ligaments stay sutures and McCalls's culdoplasty sutures long, in tractors for future plication.

Dissection is done to separate vaginal mucosa from deep endopelvic connective tissue. The dissection is continued laterally until the index finger could be passed between the vaginal epithelium and the pubocervical fascia into the retropubic space, and upto anterior to ischial spines. With surgeon's finger in retropubic space, the dissection is continued anteriorly along the inferior ramus of pubis. This dissection could be very bloody and cautery should be utilized to stop the bleeding. Arcus tendineus fascia pelvis and fascia overlying obturator internus is identified upto ischial spines. Permanent suture material is preferred for stitching.

The first suture is placed in arcus tendineus fascia pelvis 2 cm anterior to ischial spine. Traction placed on this suture makes arcus tendineus fascia pelvis more prominent and a series of 4 to 6 sutures are placed similarly in arcus tendineus fascia pelvis upto pubic symphysis. All the sutures are kept long, on tractors, outside the surgical field, on needles and numbered. This simple precaution avoids confusion at the later stage (Fig. 23.7).

Next, the suture that is placed closest to pubic bone is used to penetrate the edge of periurethral pubocervical fascia near the mid-portion of urethra. The same suture is then used to penetrate the under surface of vaginal epithelium distal to urethrovesical junction. Second suture is placed at the level of urethrovesical junction and so on, till the first suture in arcus tendineus fascia pelvis secures the vaginal apex (Figs 23.8 and 23.9).

It is necessary to place vaginal sutures several centimeters away from cut midline edge, to allow adequate tissue for midline closure. When all sutures have been placed, they are tied sequentially beginning with the periurethral suture and ending with the stitch nearest the vaginal apex. A similar procedure is repeated on the other side finishing bilateral paravaginal repair. If a midline defect is present anterior colporrhaphy is done.

If hysterectomy has been done, the peritoneal and culdoplasty sutures are tied. The culdoplasty suture is also used to attach superior portion of anterior vaginal muscularis to apex of vagina. The cut edges of vagina are approximated with interrupted absorbable sutures. Posterior repair, if required, is done now.

Obtaining adequate visualization and surgical lighting makes this procedure challenging and as such, is associated with more potential morbidity than abdominal approach. There is a greater risk of intra-

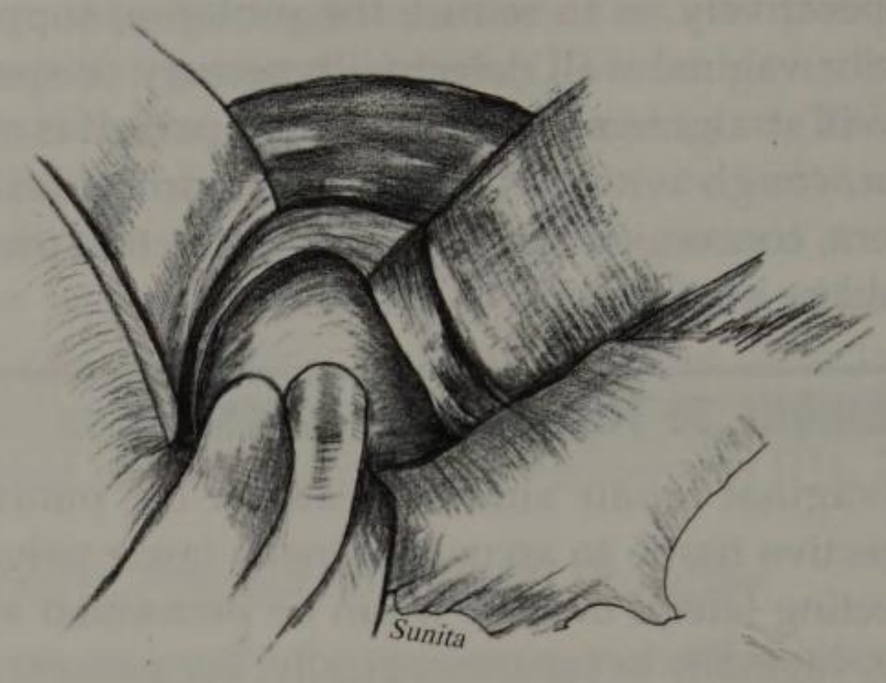


Fig. 23.7: Vaginal paravaginal repair: End of dissection , White line is visible at lateral pelvic wall. Lighted retractor is retracting bladder medially

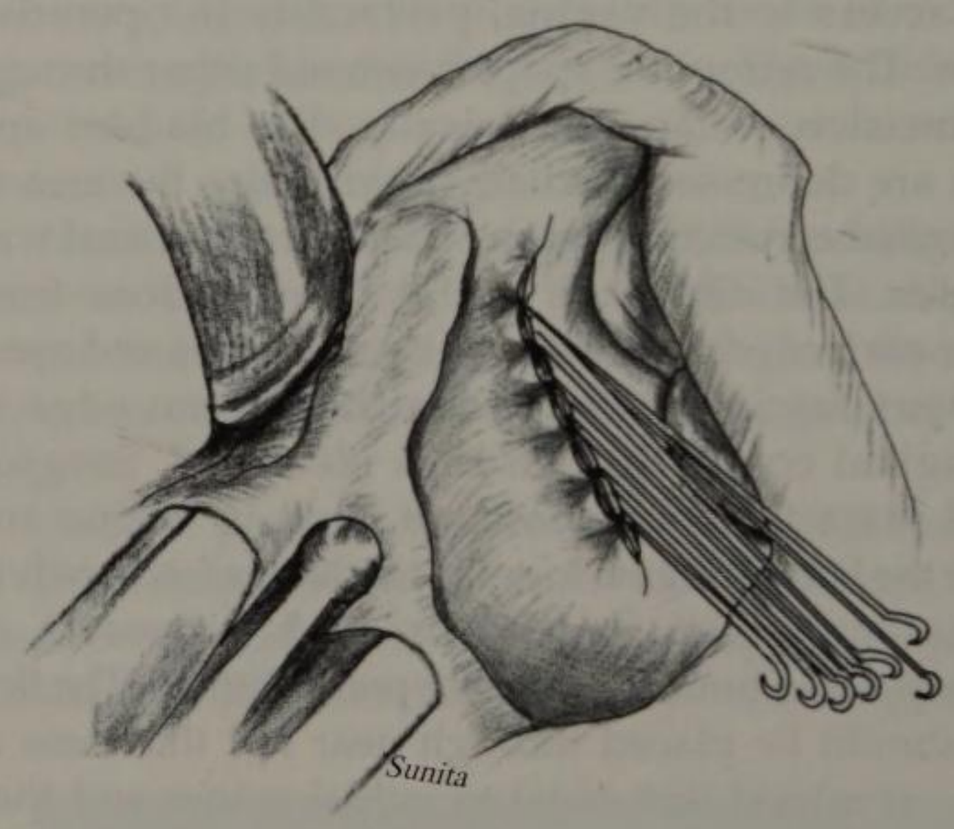


Fig. 23.8: Vaginal paravaginal repair: Sutures put in white line, held long and on needles

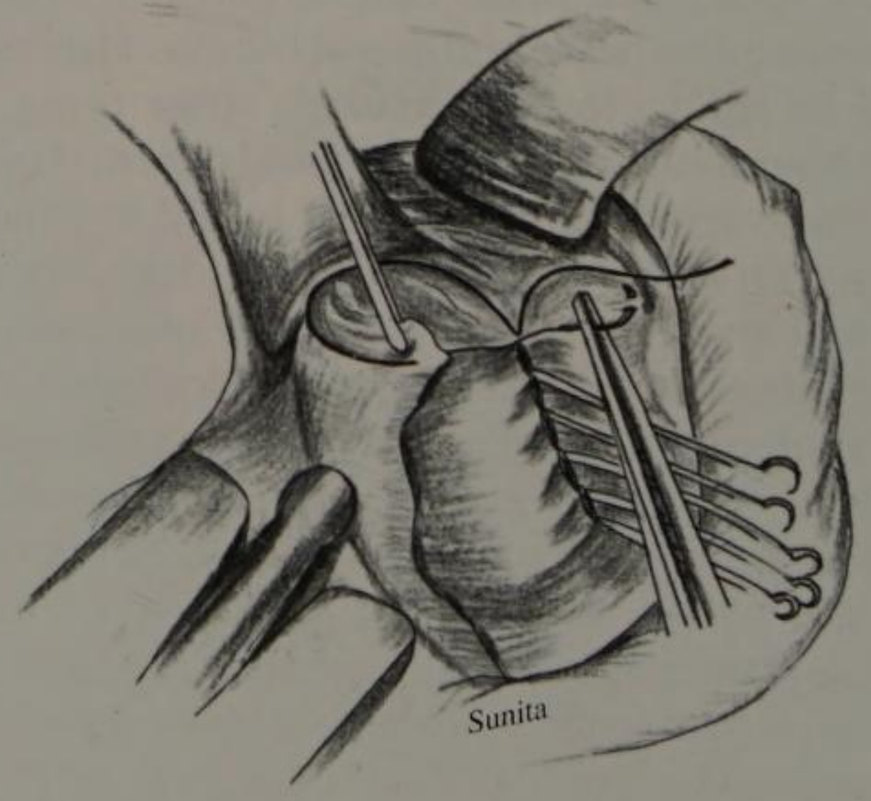


Fig. 23.9: Vaginal paravaginal repair: Sutures being taken through pubocervical fascia and next through vaginal muscularis

operative haemorrhage. One case series had a 3% incidence of major intra-operative haemorrhage and 16% incidence of transfusion.[9] As a result of technical challenges involved with this coupled with operative morbidity, this procedure has generally fallen out of favour.

On the other hand, in Shull et al case series no patient required transfusion. 21 of 56 (37.5%) had some degree of defect recurrance on follow-up at 1.6 years, though no patient required repeat surgery. He recommends use of transvaginal paravaginal repair for patients not requiring corrective surgery for stress urinary incontinence.[5]

Reported failure rates for paravaginal repair range from 3-14%. Controlled comparative studies are required to address whether paravaginal repair is required for the treatment of cystocoele in the presence of lateral defects.[10]

ANTERIOR COLPORRHAPHY

Middle defects in the anterior vaginal wall, or defects that are felt to be the result of generalized attenuation of the tissue, are traditionally repaired with an anterior colporrhaphy.[4] The patient is placed in the dorsal lithotomy position with her legs elevated in stirrups. The vagina is painted and draped and a Foley catheter is placed in the vagina. The anterior vaginal wall can be injected with hemostatic solution if desired. An Allis clamp is placed 1 cm proximal to the external urethral meatus. An additional clamp is placed near the vaginal apex, delineating the extent of dissection. A midline anterior wall or inverted T incision is made through the vaginal mucosa between the clamps (Fig. 23.10). Metzenbaum scissors are then used to dissect the vaginal mucosa off of the underlying tissue heading toward the lateral vaginal sulcus and pelvic sidewall (Fig. 23.11). The dissection is carried out until the entire length and width of the anterior wall defect has been dissected off of the underlying bladder (Fig. 23.12). If required excess mucosa can be trimmed at this stage (Fig. 23.13). The vaginal muscularis and adventitia must then be plicated in the midline to buttress the attenuated tissue. A suture is placed just medial to the dissected edge of the vaginal mucosa flap through the muscularis and adventitia (Fig. 23.14). Typically, delayed absorbable suture is used to reduce the risk of vaginal erosion, but some experts choose to use permanent suture material depending on the quality of the patient's tissues. These stitches are tied in the midline without tension (Fig. 23.15). This plication can be done in 2 layers if the defect is large. The excess mucosa is then trimmed and the mucosa is closed using no. 3-0 delayed absorbable sutures in a running fashion or by near far – far near interrupted sutures (Fig. 23.16).

Whereas this form of repair is the traditional technique, there has been little scientific research documenting its efficacy. Weber randomized women to 3 different anterior colporrhaphy techniques. One group underwent a traditional anterior colporrhaphy. One group underwent an "ultralateral" anterior colporrhaphy in which the dissection was carried out laterally to the public rami. The last group underwent a traditional

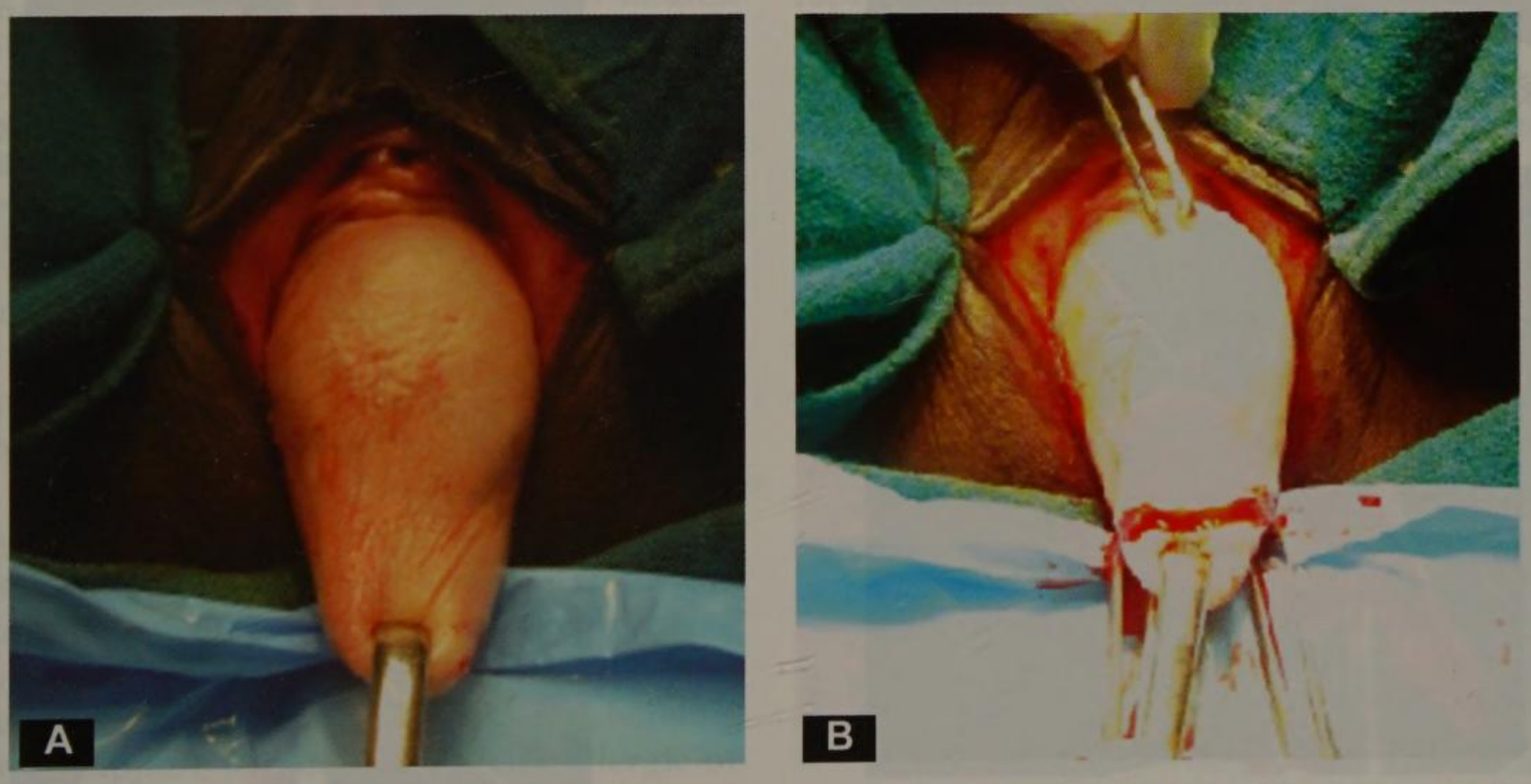


Fig. 23.10: Anterior colporrhaphy (A) cervix held with vulsellum, (B) incision in anterior vaginal wall

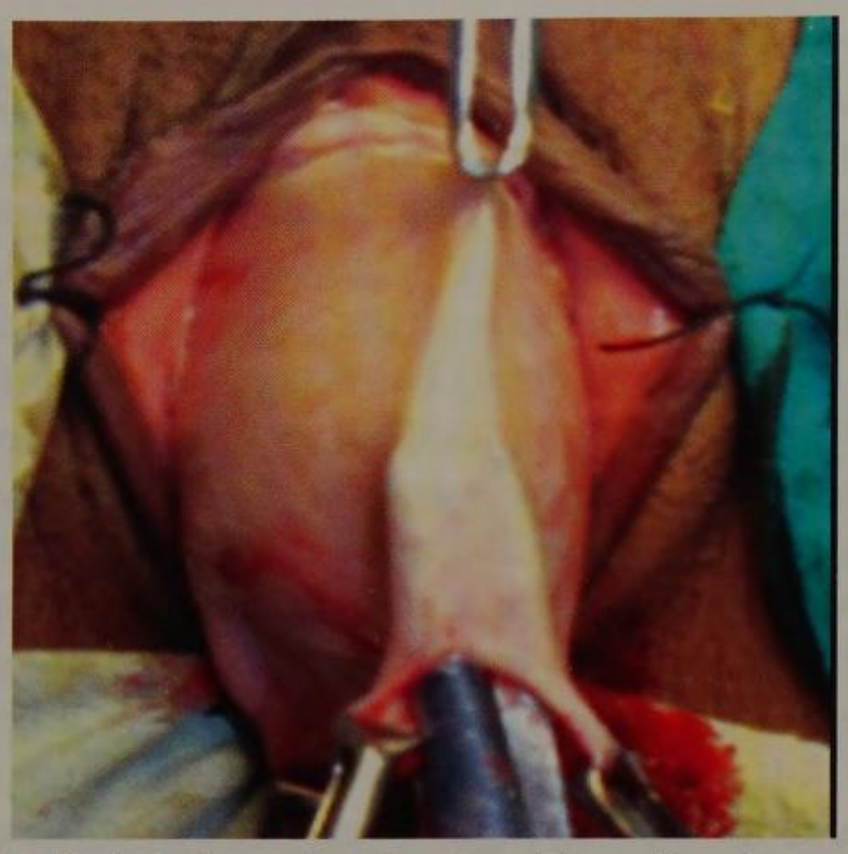


Fig. 23.11: Anterior colporrhaphy—Dissection to separate bladder from anterior vaginal wall

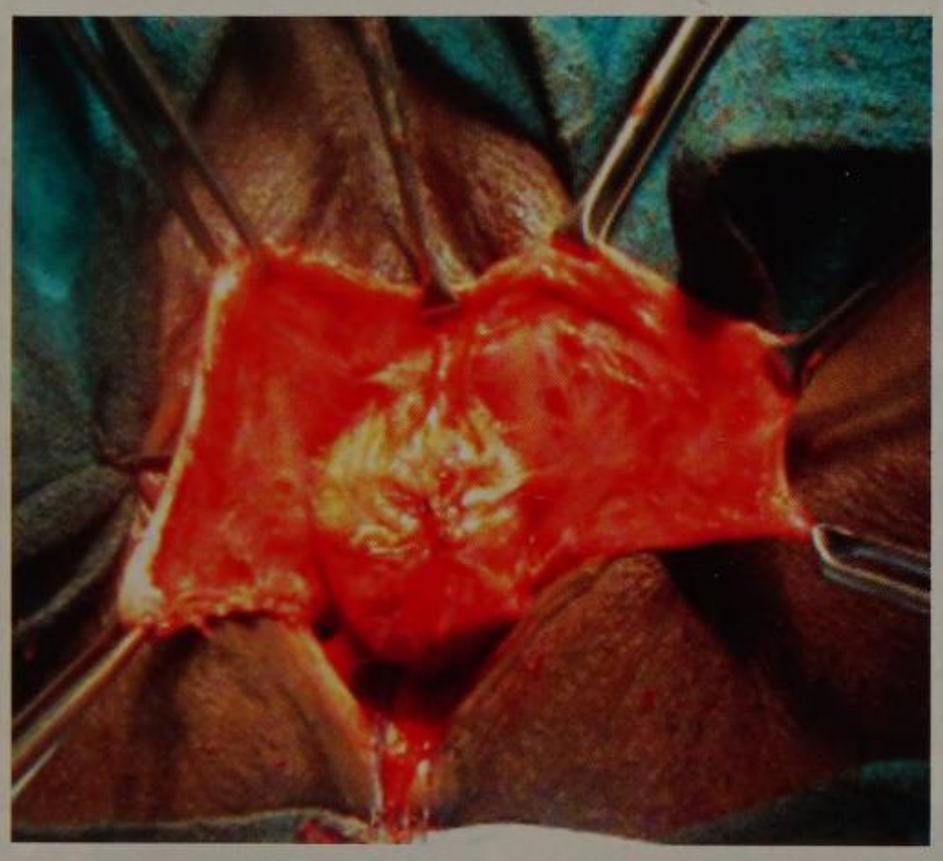


Fig. 23.12: Anterior colporrhaphy—Completed dissection

Fig. 23.13: Anterior colporrhaphy—Trimming of excess mucosa

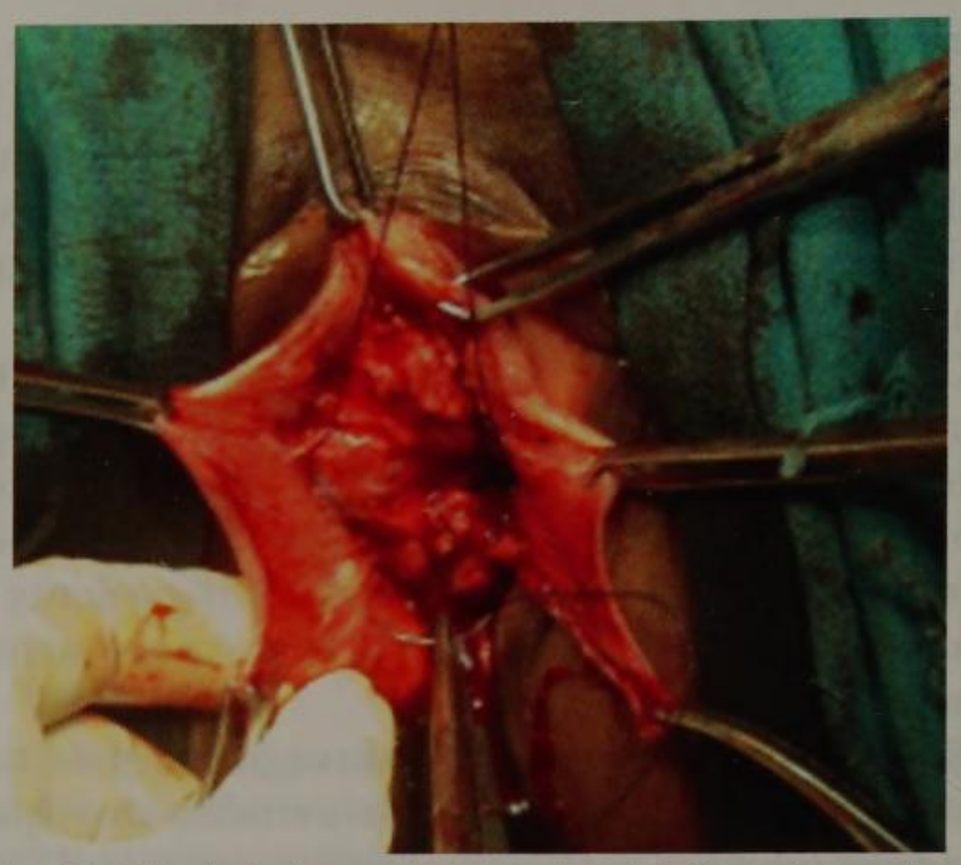


Fig. 23.14: Anterior colporrhaphy—Buttressing sutures being taken in vaginal adventitia and muscularis

Fig. 23.15: Anterior colporrhaphy—Tying buttressing sutures ,making a shelf of tissue in the midline

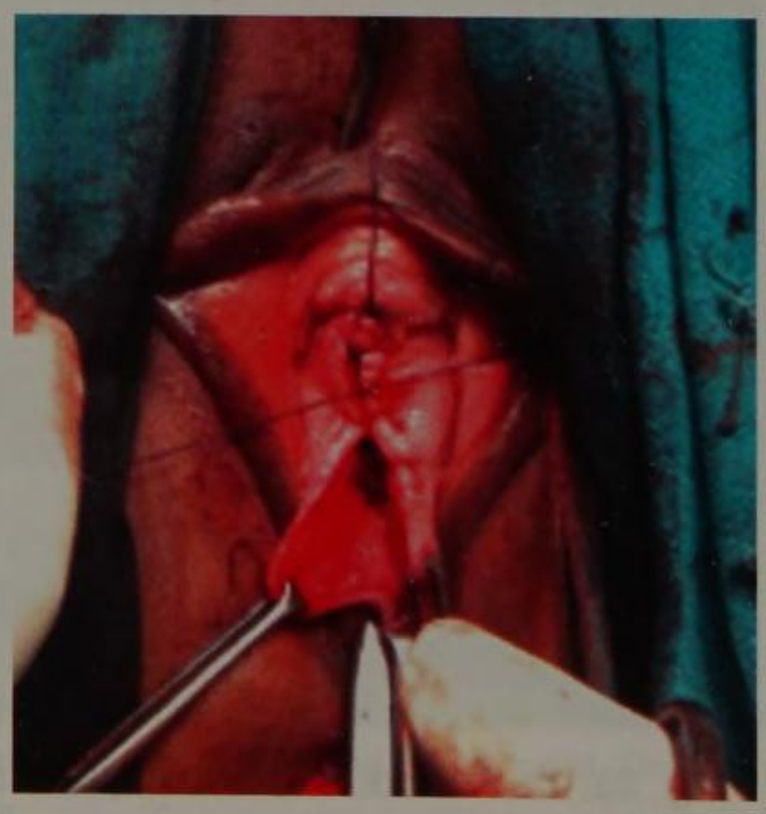


Fig. 23.16: Anterior colporrhaphy—Vaginal closure

colporrhaphy followed by reinforcement with a piece of Vicryl mesh that was anchored laterally to the limits of the dissection. At a mean follow-up time of 23.3 months, the authors found that the anterior vaginal wall was at least 1 cm above the hymen in 30% of the traditional group, 42% of the standard plus mesh group, and 46% of the ultralateral group. These differences were not statistically significant. Whereas the rates of anatomic success were low, the authors commented that many patients were asymptomatic and were satisfied with their surgical success.[11]

The quantity of vaginal mucosa trimmed after plication of the muscularis and adventitial layer is at the surgeon's discretion. Because the vagina is structurally a tube, excising too much mucosa can result in narrowing the vaginal diameter with resultant dyspareunia. This is particularly a concern when concomitant posterior colporrhaphy is performed or if the patient has undergone a previous anterior repair with resection of vaginal mucosa.

TRANSVERSE APICAL DEFECT REPAIR

Repair of transverse anterior wall defect is approached as apical repair procedure. In a hysterectomised patient, this type of defect represents detachment of apical anterior wall muscularis from its continuity with posterior vaginal fascia and uterosacral ligament complex. Therefore, repair is done by uterosacral ligament suspension vaginally or abdominally,specially including anterior vaginal wall muscularis in sutures. Abdominal sacrocolpopexy for significant apical descent will also be curative. The techniques for these are described elsewhere in the text.

USE OF GRAFT MATERIAL

Considering the significant failure rates for anterior vaginal wall repair procedures (upto 20%), graft placement has been tried in an effort to increase success rates. The assumption is made that poor quality of patient's tissues are the limiting factor for success.

Many types of grafts matrerials are available. Autologous grafts comprise of autologus fascia and cadeveric fascia. Synthetic grafts are, polypropylene (prolene, marlex),Vicryl and dexon meshes. The ideal graft would integrate with patient's own tissue, building a matrix of support without inciting an allergic or inflammatory reaction. At present there is no evidence based research to document superiority of one over the other. The reported adverse effects are, infection, rejection,and fibrosis leading to severe dyspareunia.[10]

Different operators have used different techniques for graft placements. Generally, after completing anterior colporrhaphy, a piece of graft is overlaid this suture line, anchoring it to lateral limits of dissection. Vagina is closed over this mesh.[11] Others have anchored the graft material laterally to white lines, distally to urethrovesical junction, and proximally to vaginal apex,[12] with or without other repair techniques.[13]

Sand et al randomly assigned patients at primary surgery to standard repair of cystocele with or without polyglactin 910 mesh reinforcement. At one year follow up, 43% Patients without mesh and 25% patients with mesh had small cystoceles(p =.02). They concluded that mesh is useful for prevention of recurrent cystoceles.[14] Julian compared the efficacy and complications of Marlex versus standard repair in 24 patients with two or more failed anterior repairs. At 2 years, there were no recurrences in mesh group as opposed to 4 recurrances in standard repair group.[12] Cochrane database system review concludes that the use of polyglactin mesh overlay at the time of anterior vaginal wall repair may reduce the risk of recurrent cystocoele.[15]

CONCLUSIONS

Evaluation and repair of anterior vaginal wall prolapse represents a challenge for the surgeon. Careful recognition of defects pre- and intra-operatively with multiple site repairs is likely to give the best results. Newer methods like graft placement need to be considered, specially for repeat surgery cases.

Key Points

1. Support of anterior vaginal wall depends on connective tissue attachment to ATFP and intact paracolpium.
2. Paravaginal defects are difficult to treat. Repair should aim to reattach paravaginal tissue to lateral vaginal wall abdominally or vaginally.
3. Central defects are best corrected by anterior colporrhaphy.
4. Mesh overlay at the time of anterior repair may reduce the risk of recurrent cystocele.

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24 Surgical Correction of Posterior Compartment Defects

Abha Sharma

The support anatomy of posterior compartment of vagina is a complex interaction among the pelvic floor muscles, nerves and the connective tissue layer i.e, rectovaginal septum. Generally, rectoceles occur in association with other compartment defects and their repair is often an integral part of the corrective surgery. Surgical intervention may also be required for the patient having symptoms like pressure, heaviness, pain and incomplete rectal emptying.

Perineal body and its attachments with connective tissue and muscle fibres from all sides should be regarded as a central core of posterior pelvic support. Compromise in its integrity during childbirth may set off a domino effect of supportive and suspensory failure. It has a major role in maintaining the vaginal axis. Like other objectively detectable pelvic defects that are asymptomatic, a grossly damaged perineum can also be asymptomatic. In view of its key role of control, this seems strange and can only be explained, if the patient is not hiding her symptoms out of fear, by strong compensation from other pelvic muscles and connective tissue. However, because of its powerful pivotal role, if any major surgery is contemplated for other pelvic compartments, concomitant perineal body restitution becomes imperative if it is in any way deviant from acceptable normal bulk. **Thus the correct, combined surgery for posterior compartment defects is posterior colpoperineorrhaphy**.

Site Specific Defect Repair

The rectovaginal fascia starts from the cul de sac, runs downwards to merge with perineal body. Laterally it fuses into the ileococcygeal fascial covering, at the lateral pelvic wall. The tearing and separation within the RVS, occurring during childbirth because of overdistension, is thought to play the primary role as a cause of rectocele in most cases. According to A. Cullen Richardson, it has been shown that this process can cause horizontal detachments from the perineal body which itself can be damaged extensively in the process of labor, and detachments from the deep endopelvic connective tissue superiorly.[1] It must be recognized and repaired for a successful outcome. These specific defects can be fairly well delineated preoperatively by way of bidigital examination, especially in the erect posture with an accompanying Valsalva maneuver, with the index finger of one hand in the rectum and the index and middle fingers of the other hand in the vagina to detect the bulge at the site of defects.[2]

With patient in lithotomy position, part is prepared. Surgery is started by placing allis clamps at the mucocutaneous junction on either side lateral to forchette, actually just outside the junction of the posterolateral vaginal sulci. The caliber of introitus is evaluated and the width of incision should be planned accordingly, so as to avoid undue constriction of introitus postoperatively. Then the entire mucocutaneous junction between two clamps is excised by scissors (Fig. 24.1).

The dissection then can be performed in standard fashion upward and laterally with concomitant midline vaginal wall incision just short of the posterior vaginal vault, completely separating vaginal epithelium from underlying rectovaginal septum (Fig. 24.2). The dissection off the inner surface of the vaginal wall must be precisely meticulous to make certain that segments of rectovaginal fascia or any elements of connective tissue are not left behind, still attached to the vagina (Fig. 24.3). This clearing process must be carried out bilaterally to the sidewall limits but not inadvertently beyond, for this could weaken the levator muscles and might enter the ischiorectal fossa. The landmarks for the lateral dissection

Fig. 24.1: Posterior repair—Incision at mucocutaneous junction at posterior aspect of intraoitus

Fig. 24.2: Posterior repair—Incision being extended vertically in posterior vaginal wall with metzenbaum scissors

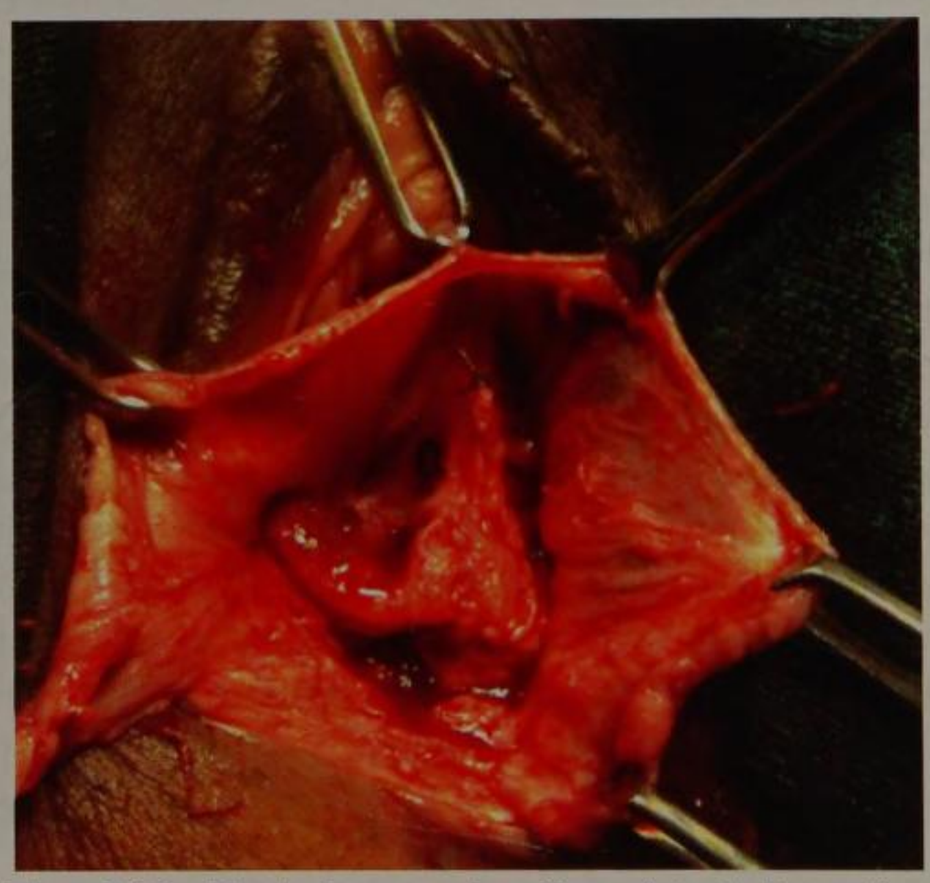
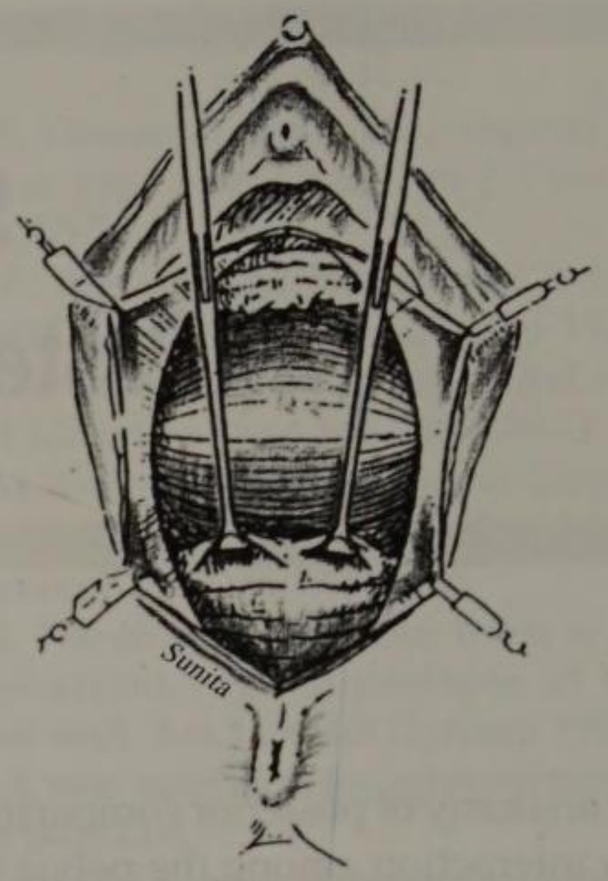


Fig. 24.3: Posterior repair—Completed dissection



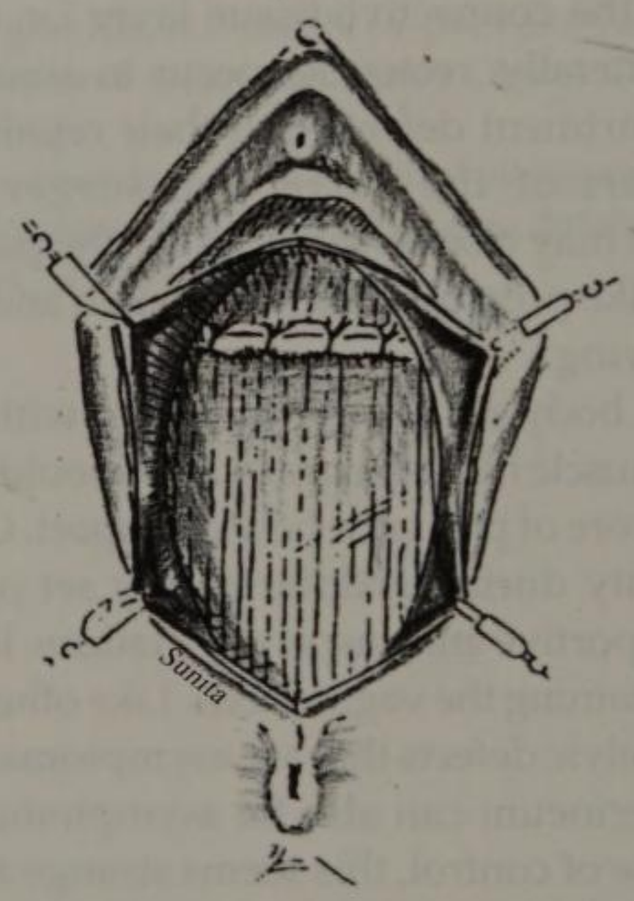


Fig. 24.4: Transverse tear in RVS at vault: (A) Clamps are drawing retracted fascia to its normal position over the rectocele, (B) Site specific repair of tear obliterating the bulk of rectocele

boundaries are, the posterolateral vaginal sulci on each side. Dissection depth can be regarded as complete once the level of the ischial spines has been reached, and they can easily be identified by palpation.

The major conceptual breakthrough discussed in this chapter is that **tears in Denonvilliers fascia, not attenuation, is the cause of a rectocele**. All the specific tears in the septum are now recognized and their torn edges held in allis clamps. Several characterstic configurations have been described namely : transverse tears, "U" shaped tears, Hockey shaped tears or multiple defects. Figure 24.4 reveals a transverse RVS tear at the vaginal vault with the separated segment, retracted into

the perineal area, being drawn with clamps upward to be repositioned in its normal environment preparatory to surgical reunification. The edges of the torn fascia are then sutured together with a series of interrupted delayed absorbable sutures. Figure 24.5 displays exactly the opposite type of tear, that is, RVS transversely torn as its fibres enter into their perineal body attachment. Here the clamps are shown drawing the RVS segment that has retracted upward being drawn down to the perineal area for operative realignment. In each case a rectally inserted index finger can demonstrate that except for scraps of areolar tissue, the anorectal mucosal wall is the only layer that prevents the finger from falling into the operative field as it produces rectocele simulation with forward pressure. When the clamps draw the long torn RVS segment into normal anatomic position the anorectal finger cannot advance at all, despite strong effort, because of the natural strong barrier effect of the replaced RVS. Although these two types of transverse detachment seem to be the most common, others that are either U-shapes at the top of the posterior compartment are not that unusual (Fig. 24.6). The same is true for more or less linear (longitudinal) tears near one side or the other directly adjacent to the pelvic sidewalls rarely in the midline. Occasionally a hockey-stick type of lesion combining a longitudinal tear and a transverse tear in continuity may be found. A rare type of combined or double defect in which the Denonvilliers fascia has been torn transversely both at the vault and at the perineal body but retaining strong attachments bilaterally is shown diagrammatically (Fig. 24.7).

All that is required is a sequential placement of interrupted stitches in appropriate point of reunion to create restitution of the normal RVS. A continuous or running stitch is anathema; the potential for bunching almost inevitable when this is done, and undue tension can ruin the operation. At the least, delayed absorbable suture material of sufficient caliber, at least 0, must be used. A good example is the popular polydioxanone (PDS Ethicon), which is monofilament. Monofilament suture is distinctly preferable to polyfilament or braided sutures because of greater resistance to infection, especially in incompletely sterile areas such as the vaginal operative fields. There are many advocates pressing for nonabsorbable monofilament suture usage because a rectocele is unquestionably a herniation and should be treated as a hernia, and because there is considerably less risk of suture penetration into the rectum with the site-specific repair than with the old traditional method.

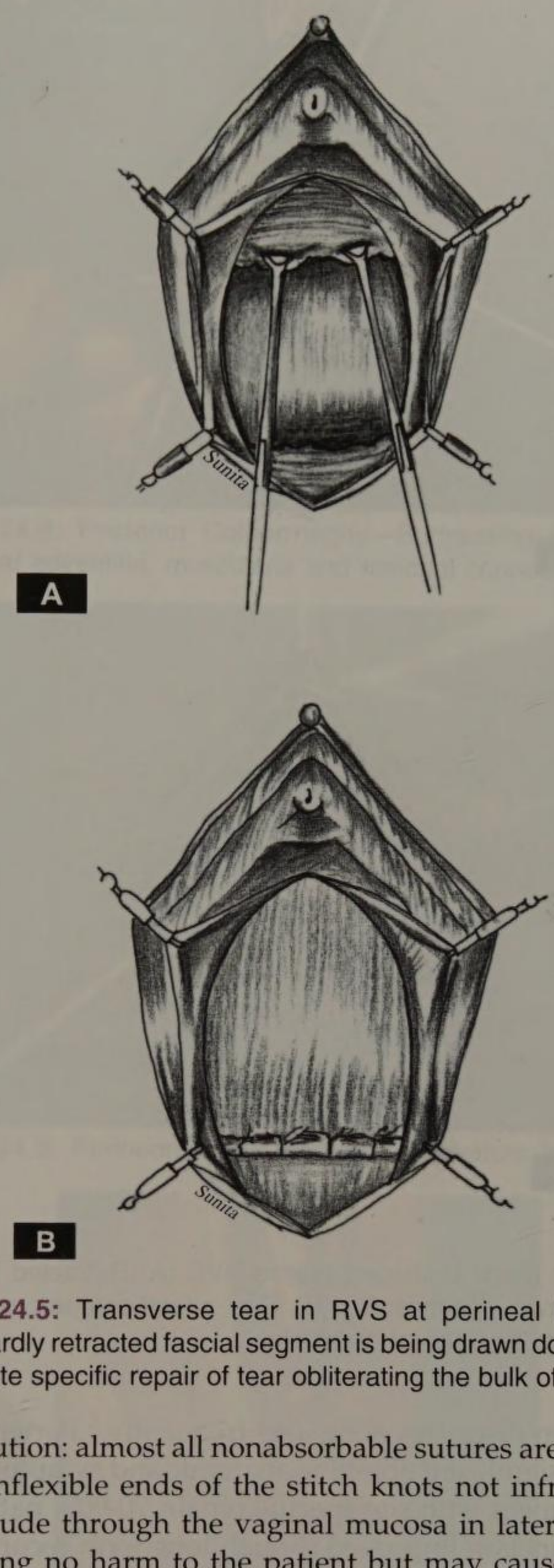


Fig. 24.5: Transverse tear in RVS at perineal body: (A) Upwardly retracted fascial segment is being drawn downwards, (B) Site specific repair of tear obliterating the bulk of rectocele

A caution: almost all nonabsorbable sutures are stiff and the inflexible ends of the stitch knots not infrequently protrude through the vaginal mucosa in later months, causing no harm to the patient but may cause pain to partner due to penile irritation.[3]

With reported anatomical failure rates between 8-18%, that are similar to those reported for posterior colporrhaphy techniques; the perceived advantages of site specific repair are two fold: (a) It seeks to restore normal anatomy,rather than plicating tissue in the midline and (b) Dyspareunia, constipation and

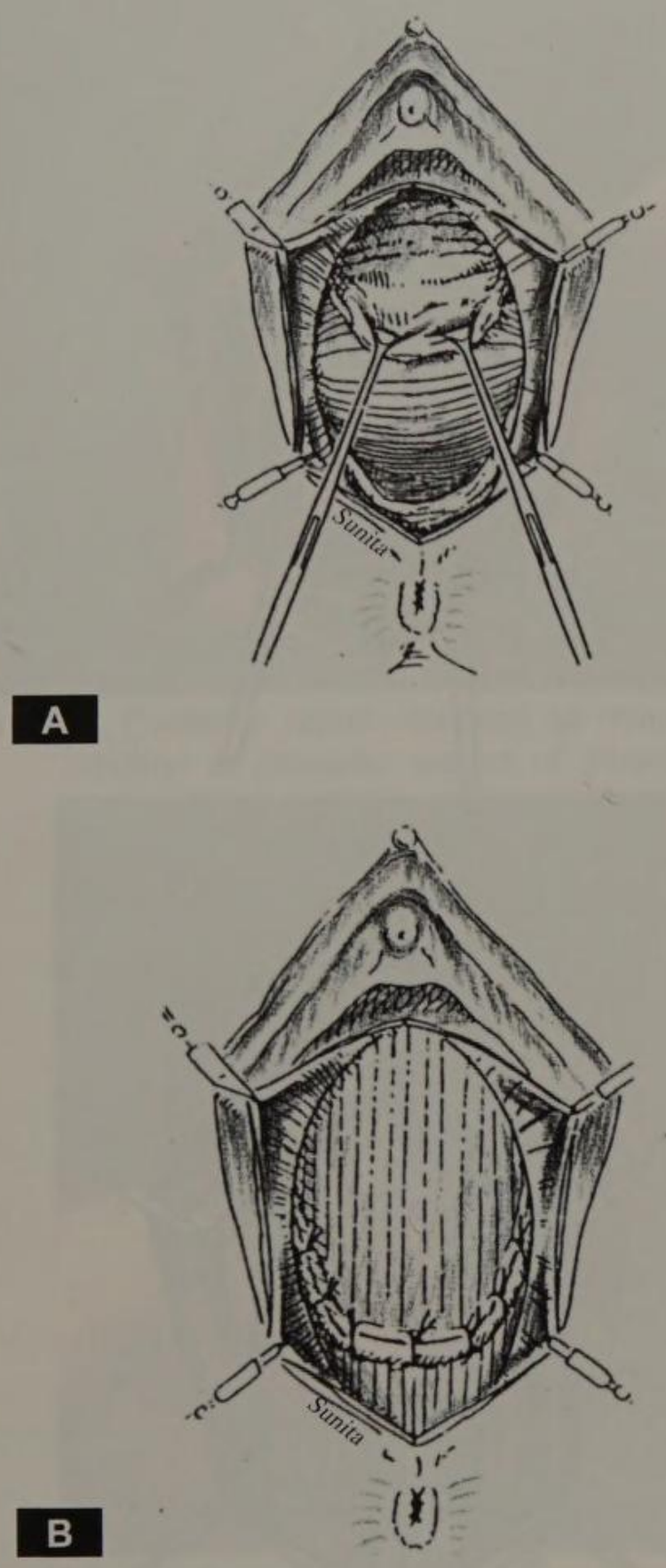


Fig. 24.6: Distal U-shaped tear in RVS (A) Retracted fascia being drawn downwards, (B) Site specific repair of tear obliterating the bulk of rectocele

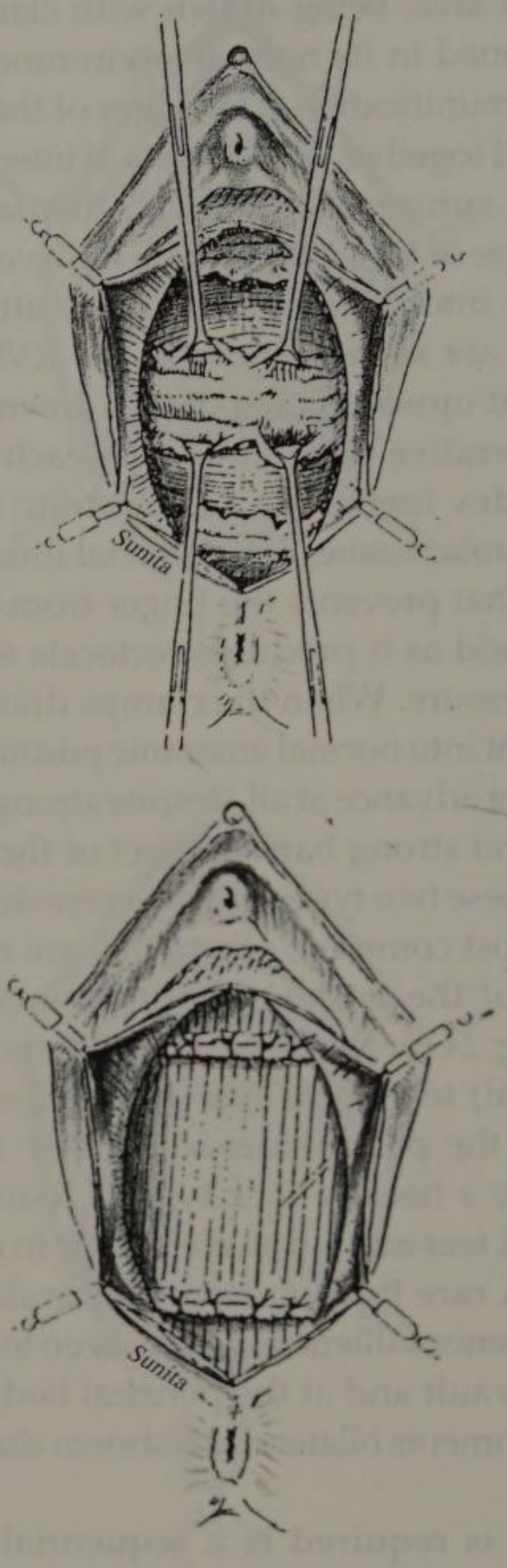


Fig. 24.7: Double defect in RVS (A) and its repair by recognizing fascial segments and suturing them together (B)

defecation disorders occur less frequently.[5] Porter et al showed significant objective anatomic and symptomatic improvement with site specific repair. 70-90% patients' sexual function improved though long term recurrence rates were not clear.[6] Evidence that a change in technique of posterior repair improves outcomes is more apparent.[7] Long term objective data are required to verify these beliefs.

Posterior Colporrhaphy

Traditionally, RVS defects have been thought most commonly to be linear in nature, primarily as the result of many years of attrition subsequent to the initial trauma of vaginal childbirth. Gynecologists have performed this surgical approach for long time, although there is not much evidence regarding the long term anatomical and functional outcomes. Objective anatomic failure rates of 25% or less and success rates for improving defecatory dysfunction in the range of 75% have been reported in several studies. Disappointingly, these same studies have reported dyspareunia rates from 12-27%.[8-10] However if anterior plication of Levators is avoided during perineorrhaphy; dyspareunia rates decline appreciably. Abramore et al reported a retrospective comparison of

standard colporrhaphy (without levator plication) to the site specific technique among 307 patients who were followed for at least one year. They reported better objective anatomic failure rates (defined as prolapse beyond the hymenal ring) in the colporrhaphy group (4% v/s 11%, P = 0.02). They found no difference between two groups with respect to de novo dyspareunia (11% in each group). This important finding might be explained by their avoidance of levator plication in both groups.[11]

The procedure starts with dissection in rectovaginal space as described earlier. Then a series of side-to-side stitches are taken in vaginal muscularis, beginning just posterior to the level of the ischial spines and extending down to the area of the perineal body (Fig. 24.8). The tissues united from each side were a combination of residual connective tissue, areolar tissue, segments of lateral wall fascia and muscularis. Perineorrhaphy is done. Delayed absorbable sutures are preferred for both plication and perineorrhaphy.

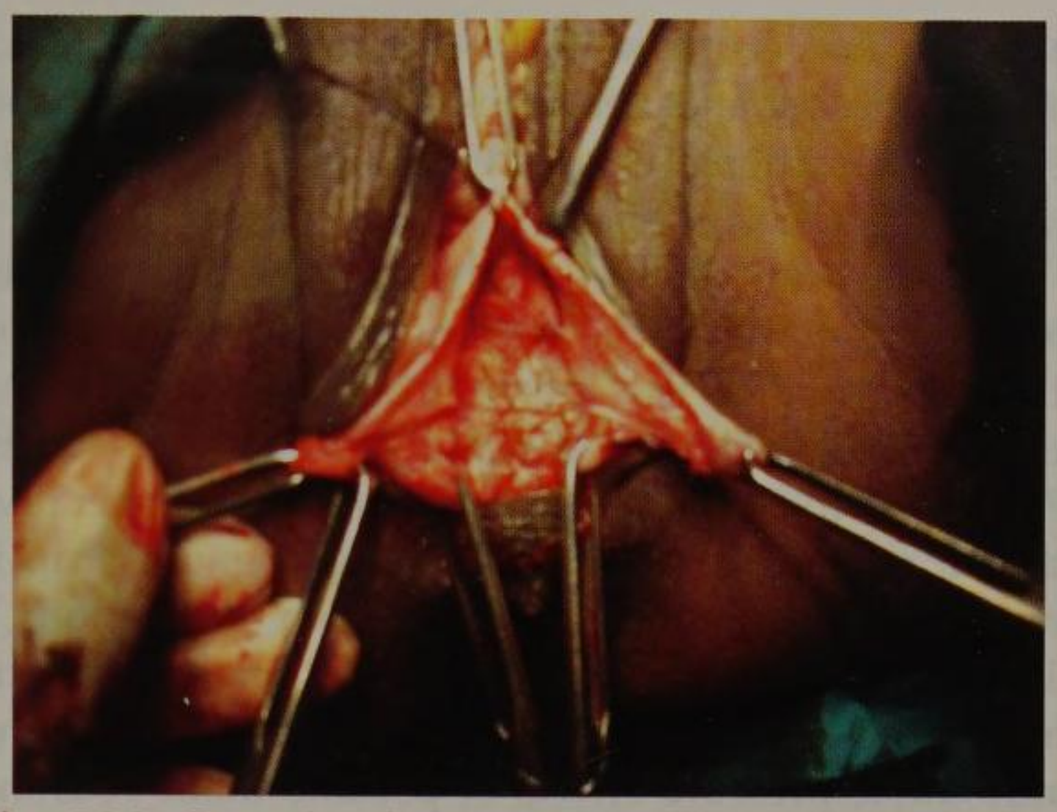


Fig. 24.8: Posterior Colporrhaphy—Buttressing sutures in vaginal adventitia, muscularis and residual connective tissue

Perineorrhaphy

A normal perineal body configuration inevitably restores the normal vaginal axis without which the entire reconstruction is threatened. This means the surgery must ensure anchorage to rectovaginal septum fibres from above and the levator plate connection posteriorly. Simultaneously one must remember that over enthusiastic restitution might seriously interfere with future coital function.

After completion of posterior colporrhaphy, levator plication is traditionally done by joining its medial most fibres in midline by sutures (Fig. 24.9). As it leads to significant dyspareunia it can be avoided.[10] Midline realignment of torn transverse perinei, bulbocavernosus, and pubococcygeal muscle fibres is described or at least implied. Defining individual muscles in scarred tissue is difficult, therefore the goal of repair is symmetrical restoration, as much as possible, by employing judiciously placed solid tissue bites into each side muscular fibres, using interrupted stitches (Fig. 24.10). Suture material can be either delayed absorbable synthetics of 0 caliber or, as many experts are currently advising, nonabsorbable suture like PDS. An anatomically correct fixed vaginal vault postero-superiorly and enterocele repair helps immeasurably in the enduring success of a colpoperineorrhaphy.

Fig. 24.9: Perineorrhaphy—plication of levators in midline

Fig. 24.10: Perineorrhaphy—Reconstruction of perineal body by placating superficial muscles of perineum in midline, thus narrowing UGH

Closure

One of the most common misconceptions of gynecologic surgeons is that excess vaginal mucosa should be

removed. This is undoubtedly the greatest single factor in the undesirable development of an inadequate post repair dysfunctional vagina. One should strictly avoid excessive excision of mucosa.

Vaginal wall closure, as the operation progresses towards completion, is routinely accomplished by starting toward the perineum with a running (continuous) locking 2-0 rapidly absorbable suture (Fig. 24.11). If colporrhaphy is performed postoperative vaginal packing with antibiotic soaked gauze strip is considered compulsory at most major institutions.It discourages serosanguinous fluid collections and protects the many delicately placed stitches against the undesirable pressure effects of postanesthetic retching and coughing that so commonly occur during this most vulnerable stage of healing.

Reinforcement through Graft Placement

Regardless of surgical technique chosen, some surgical failures will occur and these are difficult to predict. To improve outcomes, several surgeons have incorporated graft placement in reconstructive pelvic operations. Many types of grafts materials are available. Autologous grafts comprise of autologus fascia and cadeveric fascia. Synthetic grafts are, polypropylene (prolene, marlex), Vicryl and dexon meshes. The recommendations for optimum graft placement are :a) haemostasis should be meticulous, b) avoid tension on graft, therefore adequate size graft should be chosen. The graft is attached to levator ani muscles laterally, perineal body distally, and if reachable,to the uterosacrals superiorly. Vagina is closed over the graft. At present there is no evidence based research to document superiority of one type of graft over the other. The reported adverse effects are, infection, rejection,and fibrosis leading to severe dyspareunia.[3] Graft placement in posterior repair was found to be less successful as compared from its use in anterior repair.[11] Synthetic mesh erosions through the vagina are difficult to treat conservatively and are troublesome complication.

Fig. 24.11: Completed posterior repair

CONCLUSIONS

The surgical correction of posterior compartment prolapse is characterized by a wide array of results. When deciding which operative technique to use, the surgeon must rely on his or her training and experience. Although different surgical repairs described in this chapter have similar reported success rates, one cannot assume the operations as equivalent. That is because of the widely varied outcome measures used in these studies and paucity of comparative trials. The ultimate goal of surgery should be to achieve anatomical correction and symptomatic improvement, without dyspareunia and recurrance.

Key Points

1. Posterior compartment repair should be an integral part of other compartment defect repairs.
2. Correct, combined surgery for posterior compartment defects is posterior colpoperineorrhaphy.
3. Site-specific defects in rectovaginal septum should be recognised and repaired meticulously.
4. Omitting, levator ani plication may reduce the incidence of post repair dyspareunia.
5. The benefits versus complications of graft placement for reinforcement is still under research.

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25 Manchester Repair

Kiran Guleria

INTRODUCTION

The Manchester procedure for repair of uterine prolapse was first described in 1888 by Archibald Donald of Manchester, England. The original procedure consisted of anterior colporrhaphy, amputation of cervix and posterior colpoperineorrhaphy.[1] Edward Fothergill, a student of Donald later modified the procedure by including parametrial fixation (shortening, overlapping and stitching of cardinal and uterosacral ligaments to the cervical stump) and popularized the operation.[2,3] The basic principles of operation which are universally accepted were developed almost simultaneously by Fothergill of London and surgeons of Manchester; thus explaining the name of surgical procedure.

Traditionally this is considered to be the standard operation for uterovaginal prolapse where removal of uterus is not indicated. The distinct advantages of operation include cure of prolapse and correction of retroversion, besides preservation of uterus.

Indications and Contraindications

It is the operation of choice for uncomplicated uterovaginal prolapse in a young woman when uterus is to be preserved but no further child bearing is required. It is useful in cervical hypertrophic elongation with uterine retroversion. This method retains the potential for conception but since the cervix is amputated it has definite disadvantages and an undeniable increase in complications if further conceptions and pregnancies are planned. Hence, most gynecologists rarely use this procedure if fertlilty is to be conserved.[4] It is preferred that a sterilization operation should have already been performed before this surgery. Tubal ligation should not be combined with the Manchester repair because of medicolegal implications, where complications of this procedure may be wrongly attributed to the tubal ligation procedure.

Recently Skiadas et al have reported a case of recurrent uterine prolapse after laparoscopic suspension procedure. The young woman elected to have additional surgical management by Fothergill's method. Thus it is important to teach younger gynecologists about technical aspects of this surgery so as not to loose a fertility sparing alternative procedure for treatment of pelvic organ prolapse in young women.[5]

Massive and complicated uterovaginal prolapse and presence of uterine and cervical pathology are contraindications to Manchester repair.

Principles of Manchester/Fothergill Repair

1. Amputation to shorten the vaginal portion of cervix.
2. Resection and re-approximation of cardinal ligaments in front of cervical stump to elevate uterus and displace cervix posteriorly.
3. Anterior colporrhaphy and Colpoperineorrhaphy.
4. Reformation of cervical lips.

Steps of Surgical Procedure

1. The patient is placed in lithotomy position and part is cleaned and draped. Urinary bladder is emptied with a metal urinary catheter. The posterior vaginal wall is retracted with Sim's speculum and cervix grasped with volsellum and drawn out. Uterine sounding is done to determine elongation of cervix (Fig. 25.1).
2. A routine dilatation and curettage is performed. The dilatation facilitates insertion of Fothergill's

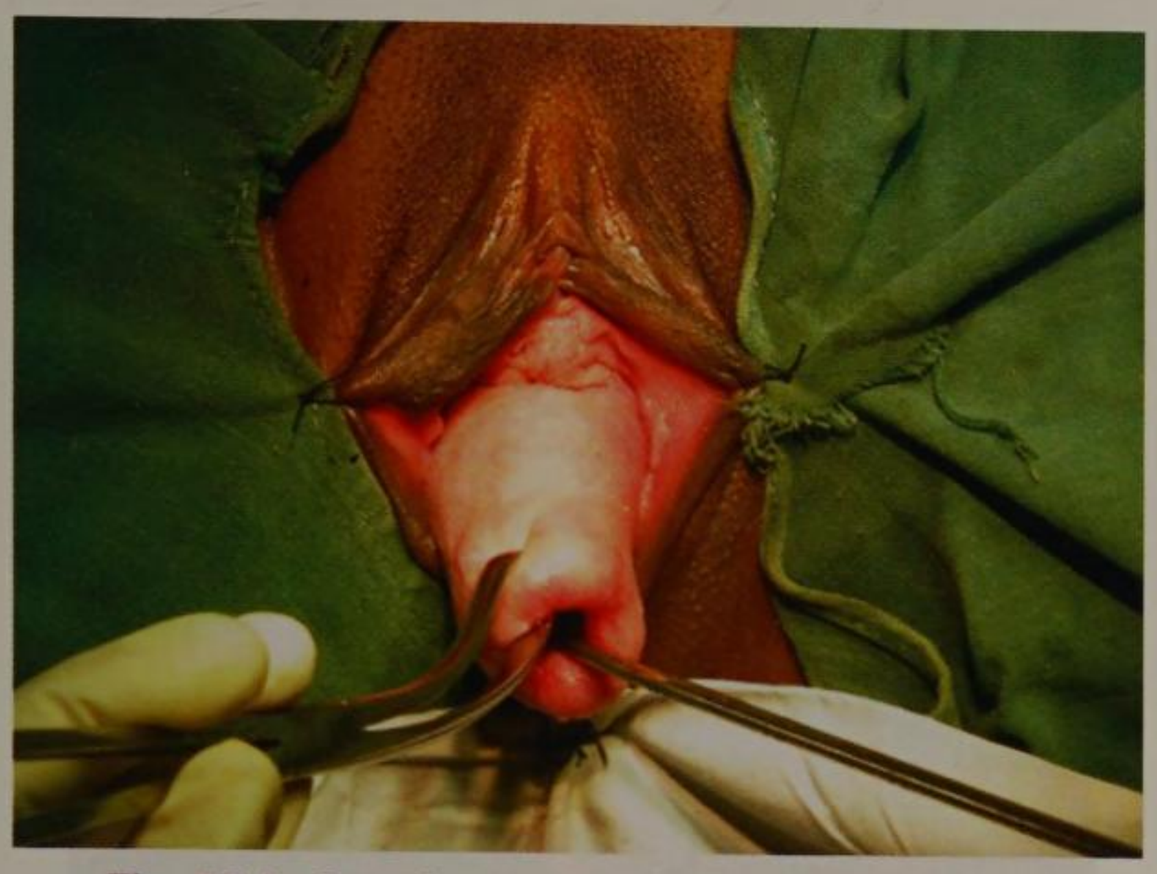

Fig. 25.1: Sounding to determine length of cervix

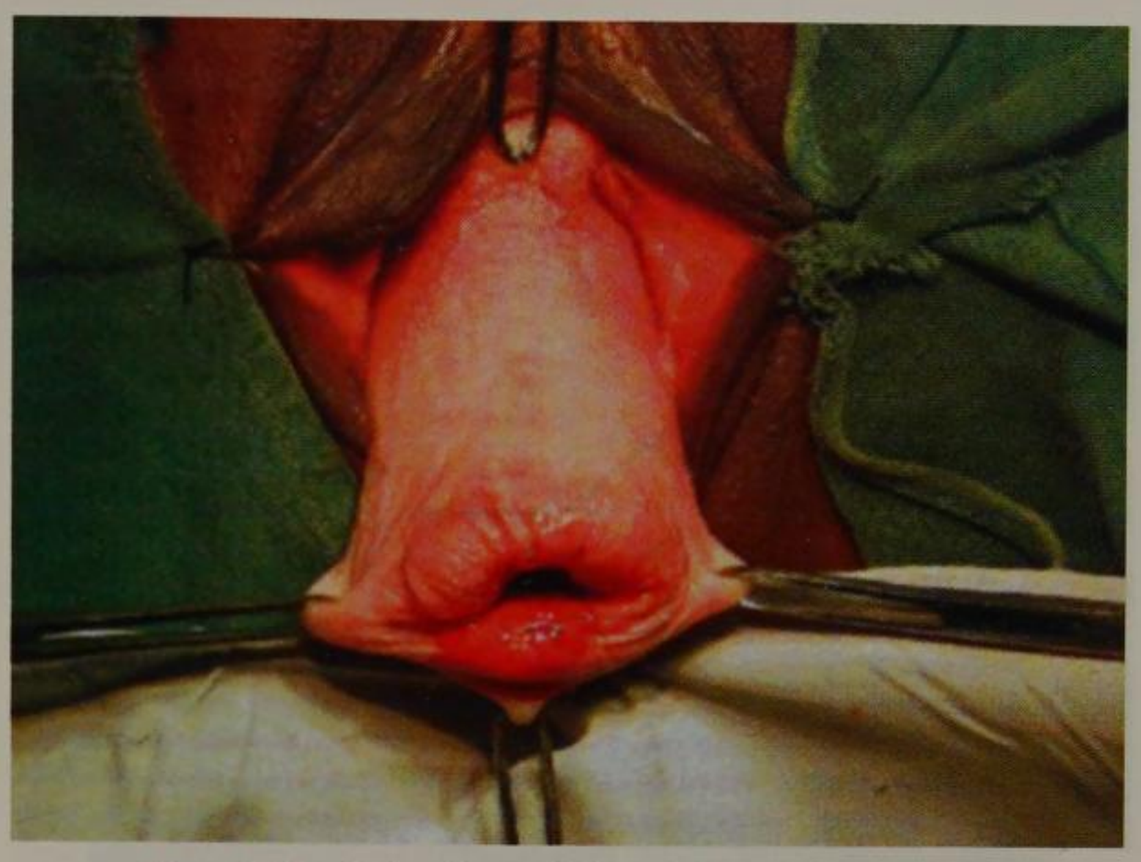

Fig. 25.3: Selection of four Fothergill's points

Fig. 25.2: Dilatation and curettage

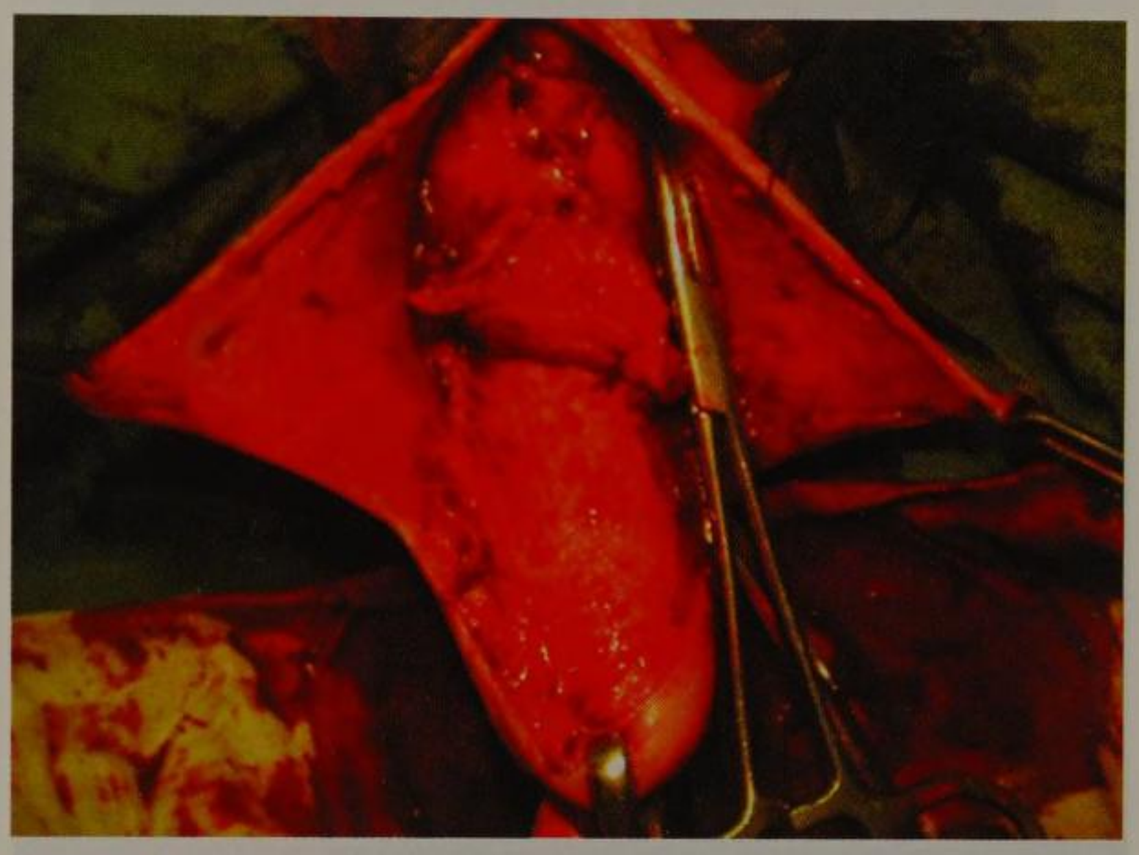

Fig. 25.4: The vaginal mucosa is reflected off the bladder by inverted 'T' incision and bladder pushed well above the level of internal os

suture and curettage excludes any asymptomatic endometrial pathology/malignancy. It also prevents any endometrial bleeding in immediate postoperative period (Fig. 25.2).

3. **Selection of four Fothergill points**: Four points are selected and grasped with small Allis tissue forceps; one above urethral sulcus, two on either side of cervix slightly posterolateral grasping anterior vaginal wall, fourth posterior to cervix grasping posterior vaginal wall in the midline corresponding to site of the pouch of Douglas. The exact position of lateral and posterior points depends upon the extent of prolapse (Fig. 25.3).
4. The first three points are joined by inverted 'T' or 'V' incision made with scalpel through the thickness of vaginal mucosa which then is reflected off bladder by sharp and blunt finger dissection. The cervicovesical ligament is recognized and divided. The bladder is pushed up well above the level of internal os until uterovesical pouch is identified. The bladder pillars if encountered on stretching the bladder up can be excised and dissected from edge of cervix. This procedure allows easy and safe amputation of cervix and subsequent insertion of sutures (Fig. 25.4).
5. The incision from lateral points is extended to posterior point in pouch of Douglas (POD) and posterior flap of vaginal mucosa is raised which will subsequently be used to cover the posterior cervical stump (Fig. 25.5).

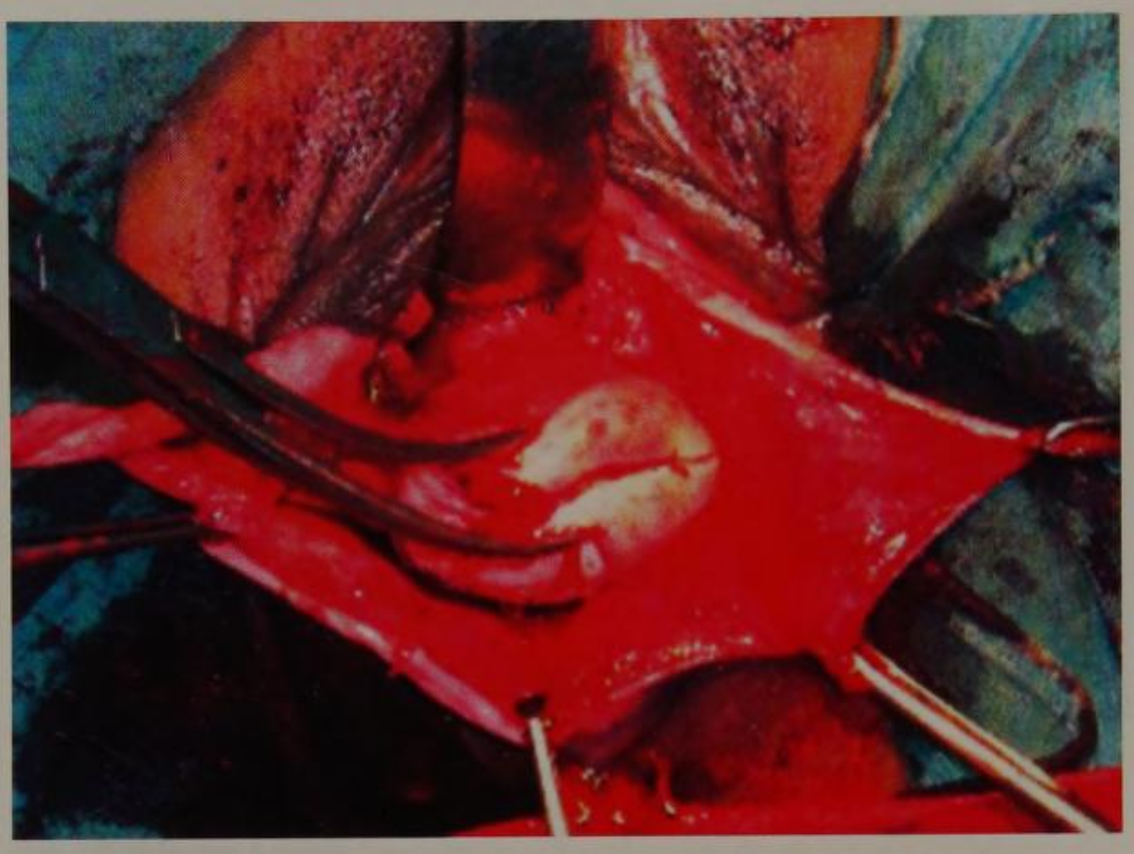

Fig. 25.5: Posterior flap of vagina being raised

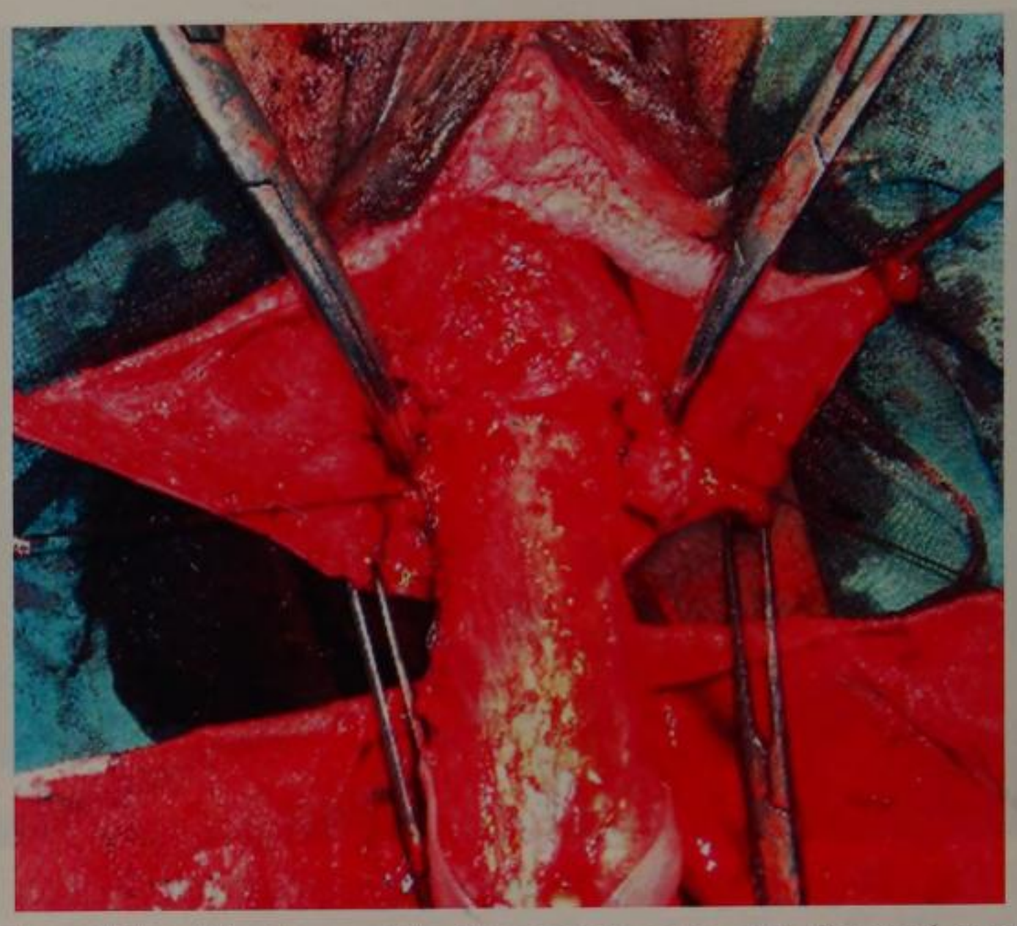

Fig. 25.7: Mackenrodt's ligaments are cut, ligated and held long

Fig. 25.6: Mackenrodt's ligaments clamped on either side

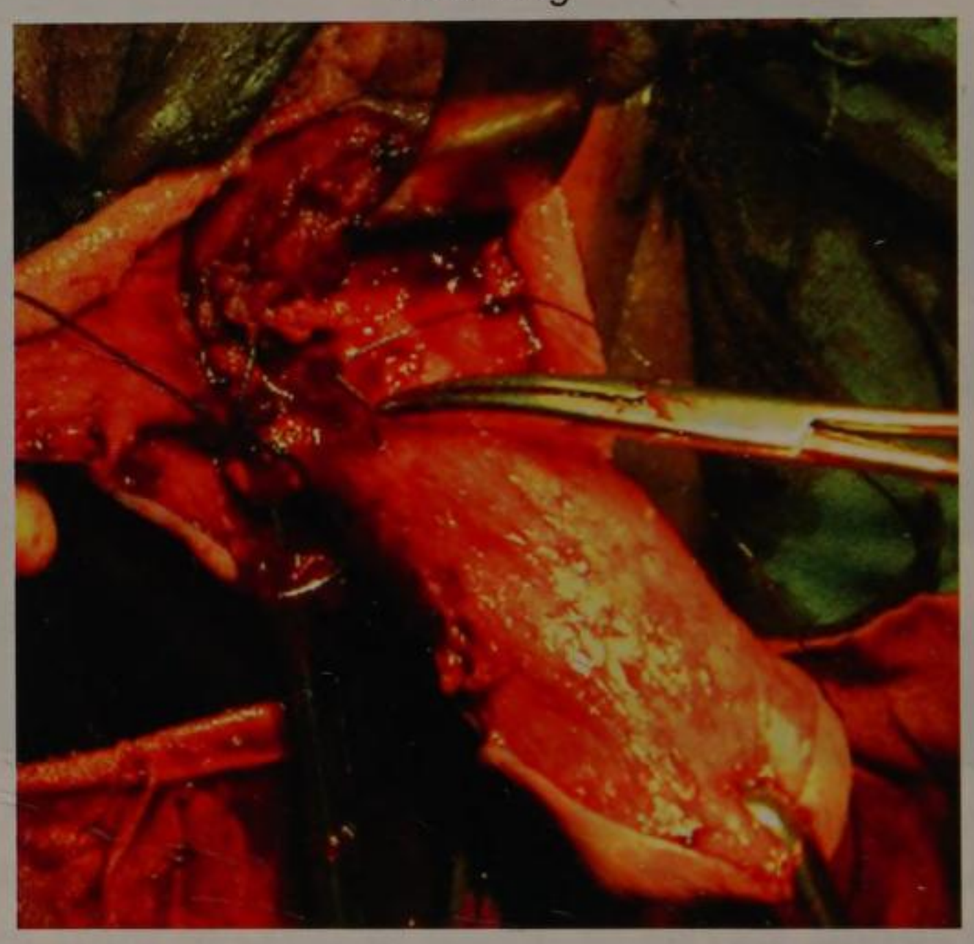

Fig. 25.8: Ligation of descending cervical branch of uterine artery

6. If an enterocele is present it is tackled at this point opening the POD, reducing it's contents, ligating the neck of sac. The hiatus between the two uterosacrals is closed by two or three sutures.
7. The vaginal mucosa is reflected further laterally for 2-3 centimeters to expose the elongated cardinal/ Mackenrodt,s ligaments on either side. The stretched parametrial tissue is visible on border of cervix. This clamped in curved Heaney's or Kocher's clamp and transected distal to clamp and transfixed with no. 1 vicryl suture with ends left long secured in artery forceps on each side (Figs 25.6 and 25.7).
8. The descending cervical branch of uterine artery is ligated on either side with No. 0 vicryl (Fig. 25.8).
9. **Amputation of cervix:** The cervix is cut across using cautery; the level depends upon the degree of elongation of cervix. Usually about 2 cm. of cervix is left from internal os so that at the end of surgery the neo cervix lies at the level of ischial spines (Figs 25.9, 25.10 and 25.11).
10. **Modified Sturmdorf's posterior suture:** This suture is applied first due to technical reasons. The posterior lip of amputated cervix is covered with already mobilized posterior vaginal flap. The apex is sutured with 0 vicryl and tied in the center

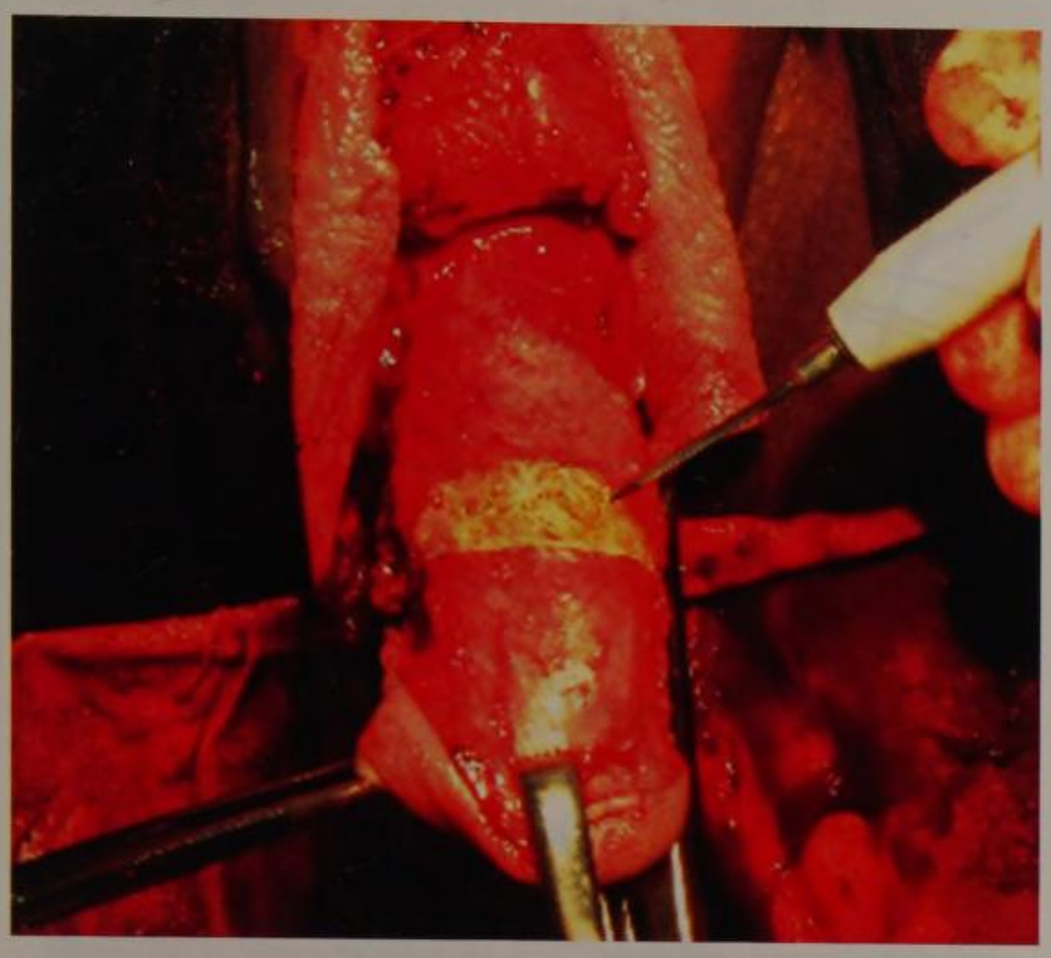

Fig. 25.9: Amputation of anterior lip of cervix

Fig. 25.11: Cervical stump after amputation

Fig. 25.10: Amputation of cervix extending to posterior lip

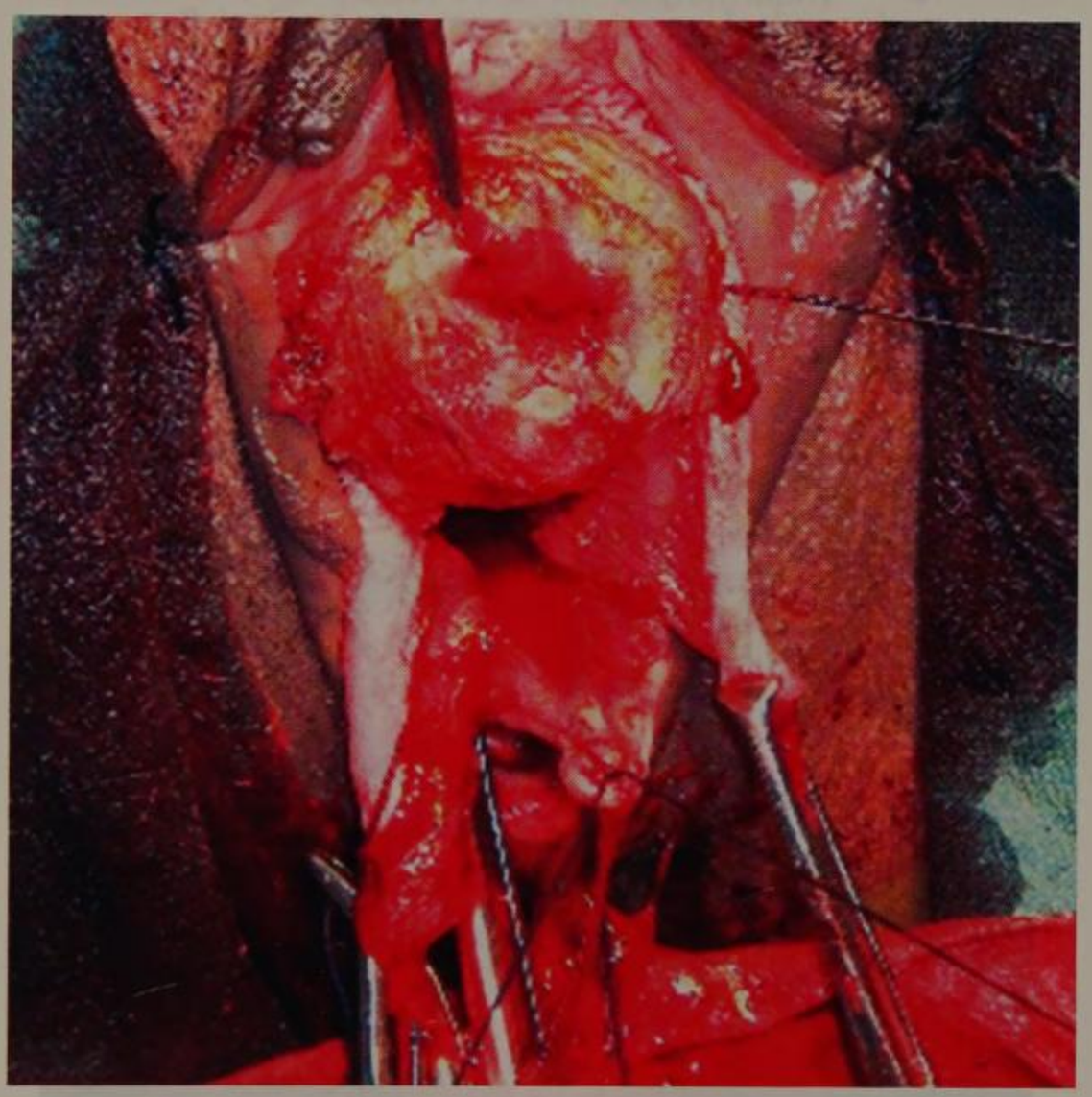

Fig. 25.12: Modified Sturmdorf posterior suture starting from posterior flap of vagina

leaving two equal length threads, which are then secured to the internal os using inside-out movement and two sutures are tied in the posterior fornix (Figs 25.12, 25.13 and 25.14).

11. **The original Bonney-Sturmdorf suture**: Alternately a strong absorbable suture is passed through posterior vaginal mucosa at 7 o'clock into the cervical canal through posterior vaginal wall, then back into center of posterior vaginal wall, whence it returns into canal and posterior wall of cervix and back to posterior vaginal wall at 5 o'clock position and tied (Fig. 25.15).
12. **Fothergill suture**: Number 1 vicryl suture is inserted at Fothergill's lateral point on patient's left

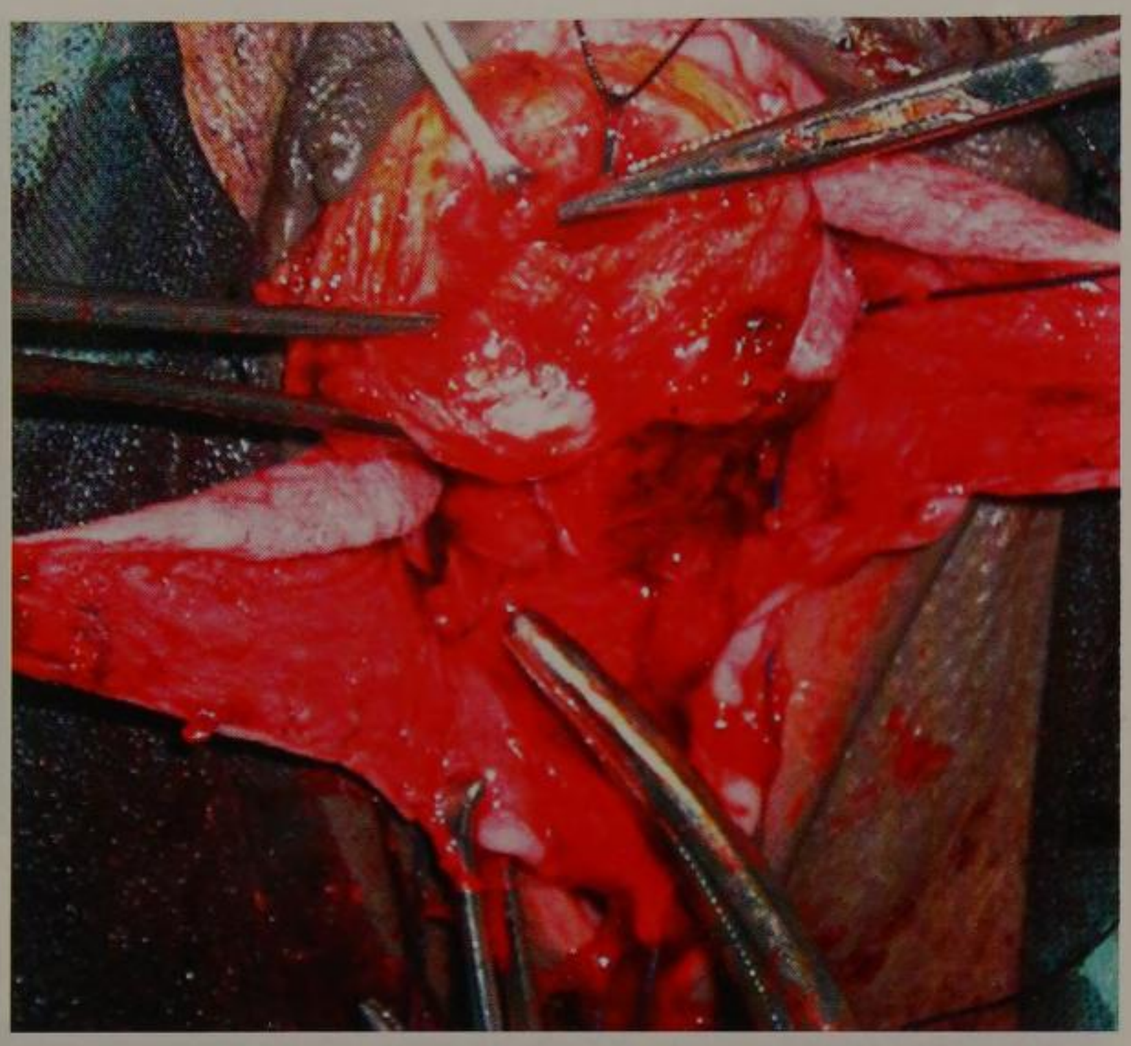

Fig. 25.13: Suture (needle) being passed from endocervical canal into posterior vaginal flap

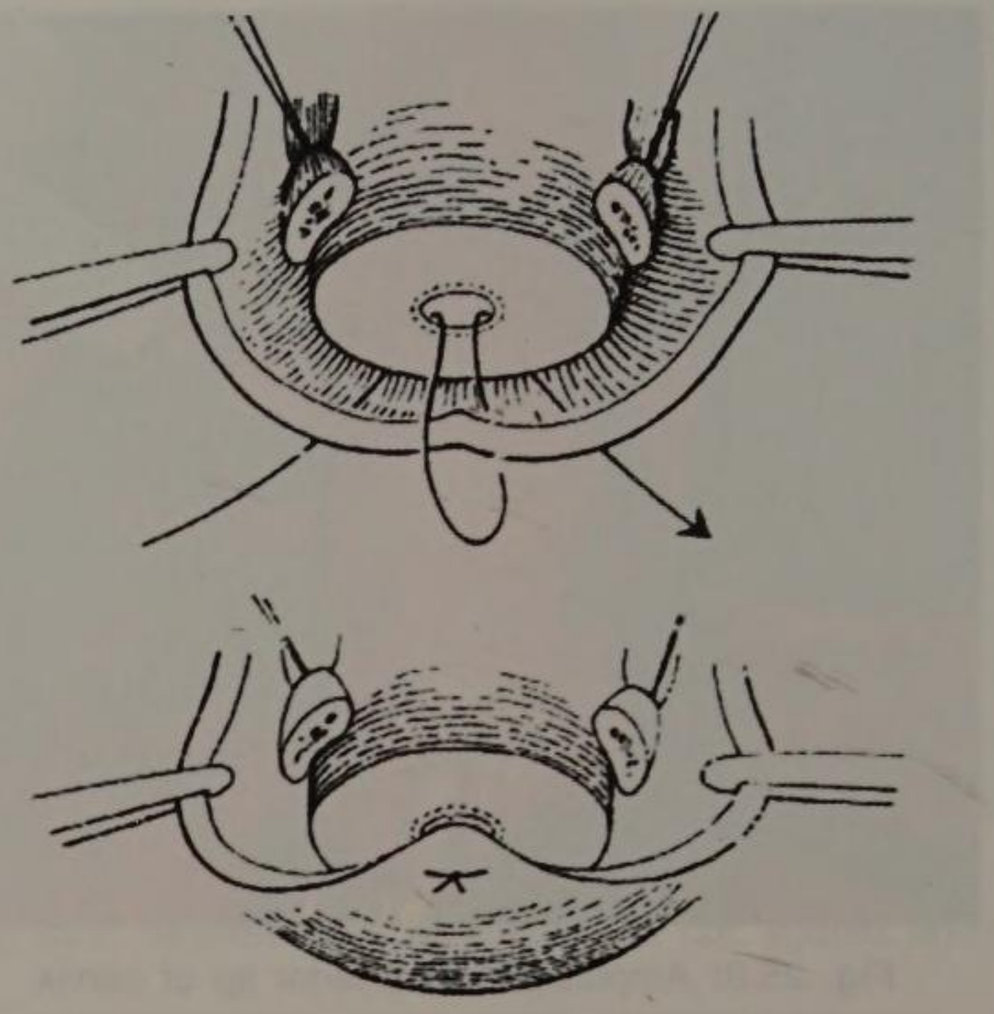

Fig. 25.15: Diagrammatic representation of original Bonnet's Sturmdorf suture

Fig. 25.14: Formation of posterior cervical lip

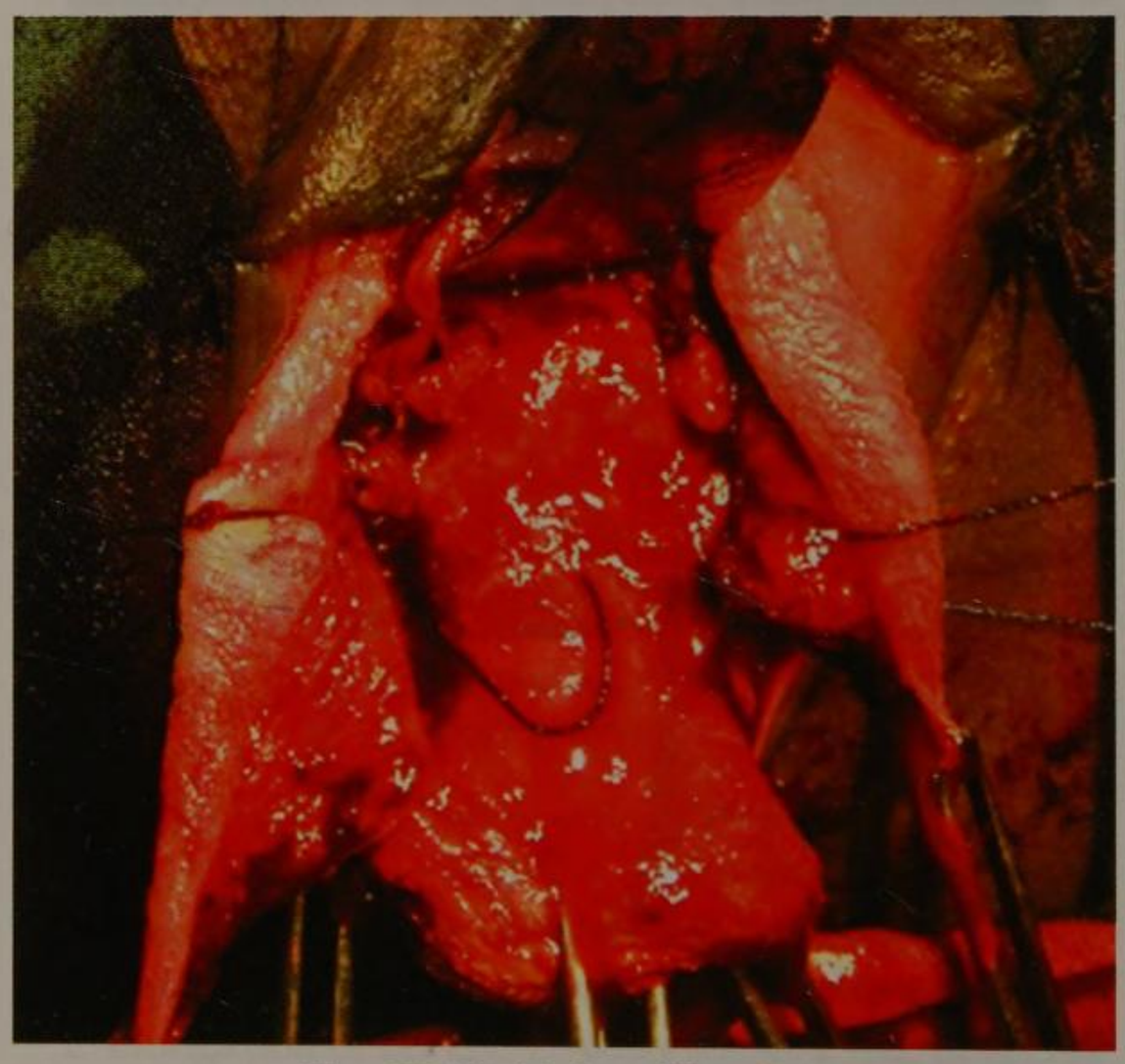

Fig. 25.16: Fothergill's stitch

side through vaginal mucosa, through divided Mackenrodt's ligament and then through midpoint of amputated anterior lip of cervix at the level of internal os from without inwards into the canal. The needle is now passed from within outwards and the process is repeated on right side (Figs 25.16 and 25.17). When this suture is tied (at the end of procedure), it brings the two Mackenrodt's ligaments together and anterior to the cervical stump thus elevating the cervix and anteverting the uterus. Similar additional sutures can be inserted to re-enforce the action of first.

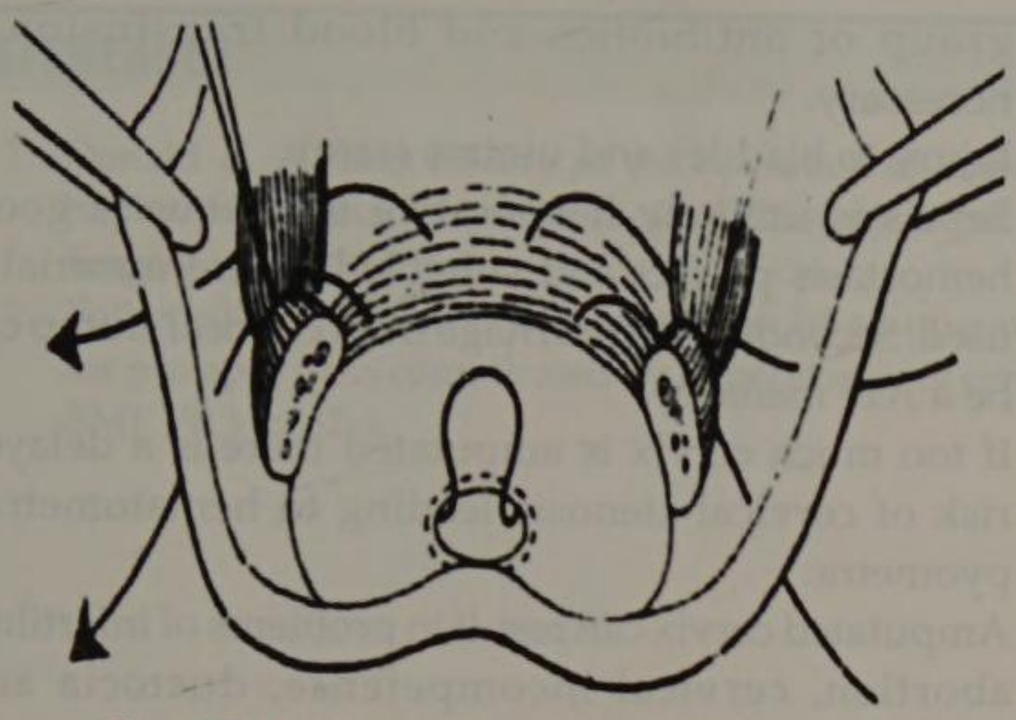

Fig. 25.17: Diagrammatic representation of Fothergill suture

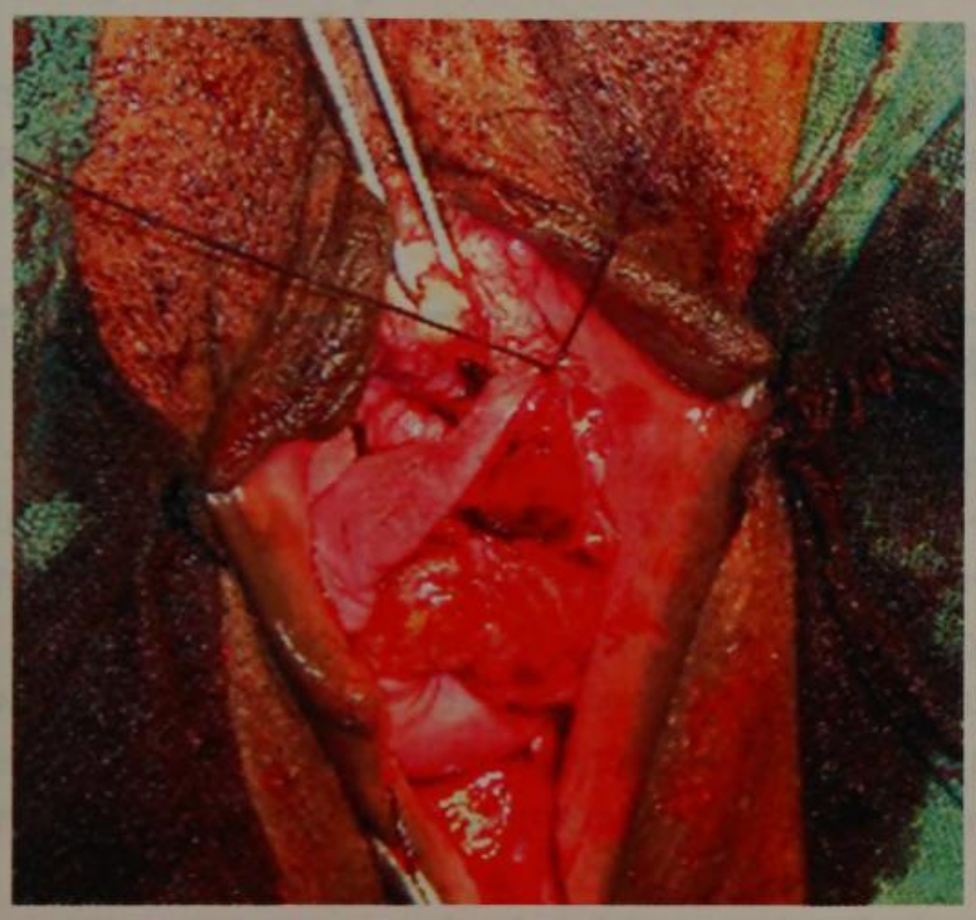

Fig. 25.18: Anterior Sturmdorf suture

Fig. 25.19: Anterior lip of cervix being formed

Fig. 25.20: Anterior colporrhaphy

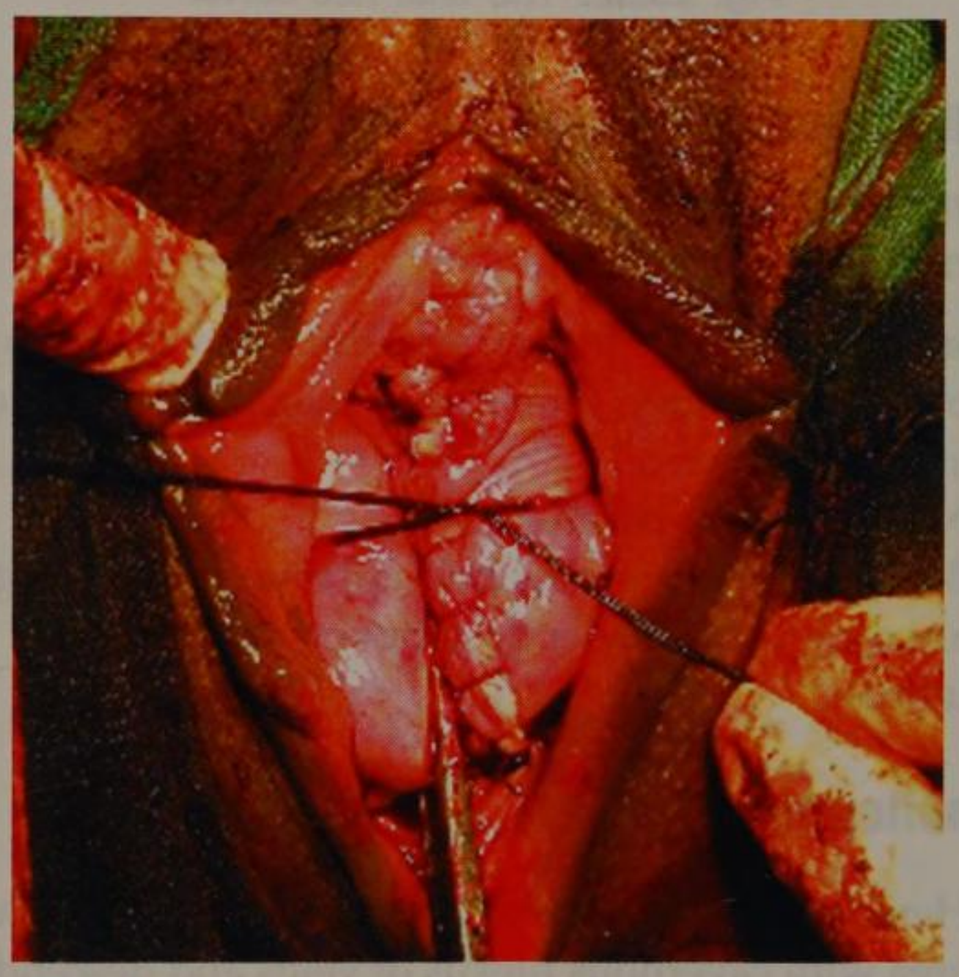

Fig. 25.21: Fothergill suture tied at the end of procedure

13. **Anterior Sturmdorf suture**: The edges of anterior flap of vagina are utilized to cover the anterior lip of amputated cervix in a similar manner as the posterior lip. A few more sutures are inserted in order to anchor vaginal skin to cervix and to ensure a neat and snug apposition of vaginal skin at level of new external os (Figs 25.18 and 25.19).
14. The **anterior colporrhaphy** is performed after excising the redundant vagina in a standard manner and the procedure is concluded after performing posterior colpo-perineorrhaphy if required (Figs 25.20, 25.21 and 25.22).

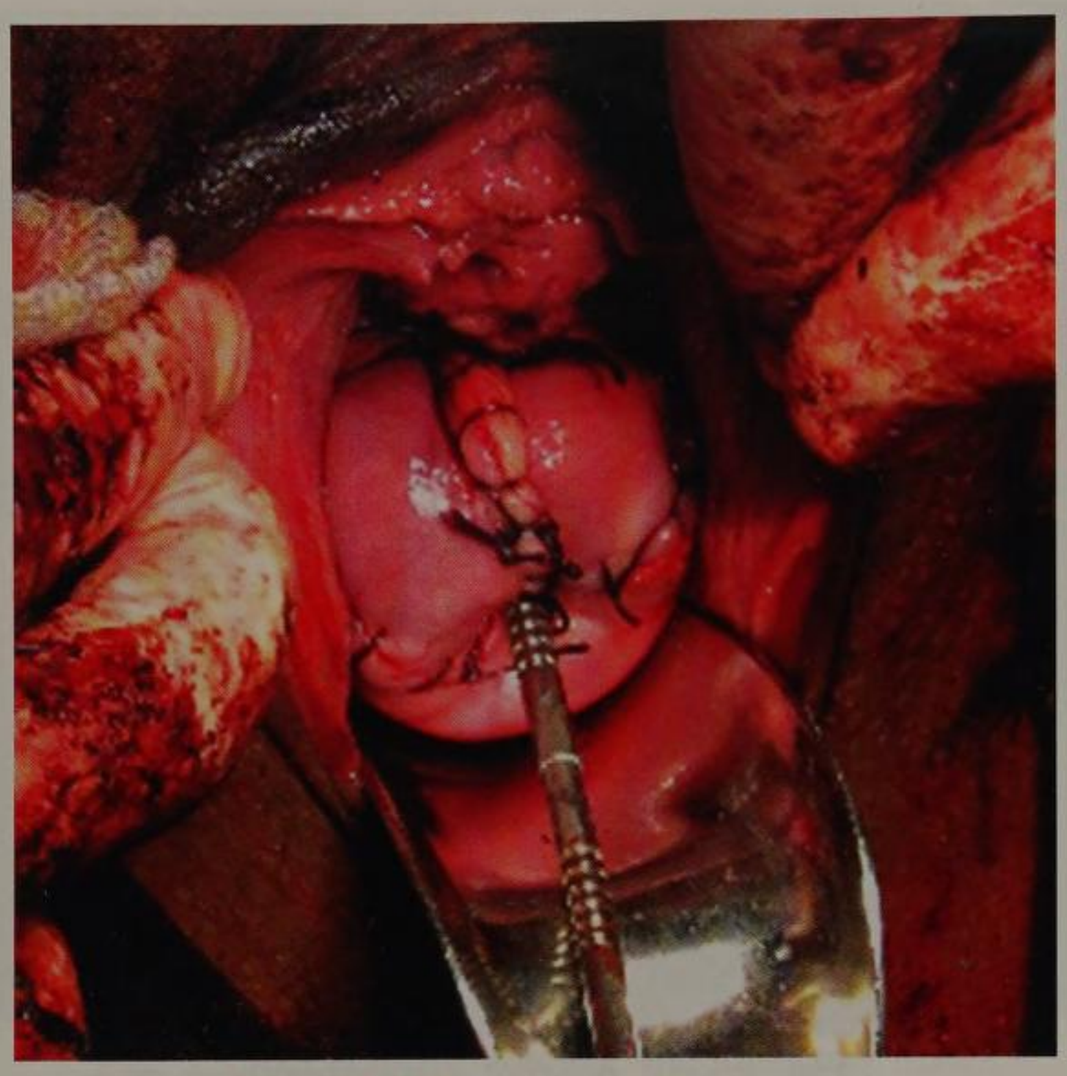

Fig. 25.22: The final neo-cervix

Modification of Procedure

Shirodhkar's Modification of Manchester Operation

In order to prevent future infertility and the complications of pregnancy, Shirodhkar suggested the following modifications

1. No cervical amputation
2. Bringing the uterosacrals anterior and fixing to anterior lip in order to antevert and anteflex the uterus.

Complications

1. Hemorrhage: The operation site involves a vascular area with cavernous plexus of veins and descending branches of uterine arteries which may result in primary hemorrhage. This can be really troublesome if correct plane of cleavage between bladder and vaginal mucosa is not entered and if descending cervical arteries are not ligated. The use of electrocautry to cut the cervix also reduces bleeding. Reactionary and secondary hemorrhage are not uncommon despite meticulous hemostasis. Secondary hemorrhage occurs around the 10th day and is the result of local sepsis. Treatment consists of higher group of antibiotics and blood transfusion if necessary.
2. Injury to bladder and ureters (rare).
3. Sepsis is unlikely if operative technique is good, hemostasis perfect and suitable ligature material is used. Secondary hemorrhage from cervical stump can be a real menace.
4. If too much cervix is amputated there is a delayed risk of cervical stenosis leading to hematometra/pyometra.
5. Amputated cervix can result in problems of infertility, abortion, cervical incompetence, dustocia and precipitate labor.
6. There is a delayed serious danger of development of cancer in cervical stump and endometrium.
7. Recurrence of prolapse may occur years later; a situation similar to nulliparous prolapse resulting in elongated cervix and a pyriform uterus.

CONCLUSIONS

Fothergill's operation is the conventional surgery for uterovaginal prolapse in women where removal of uterus is not desired. This method retains the potential for conception but since the cervix is amputated it has definite disadvantages and an undeniable increase in complications if further conceptions and pregnancies are planned. Massive and complicated uterovaginal prolapse and presence of uterine and cervical pathology are contraindications to Manchester repair.

Key Points

1. The operation cures prolapse, corrects retroversion and preserves uterus.
2. It consists of amputation of cervix and resection with re-approximation of Mackenrodt's ligaments to the anterior aspect of cervix. Amputation of cervix may be omitted in select patients to prevent infertility and complications in future pregnancy.
3. It can be a useful alternative fertility preserving surgery in select women with pelvic organ prolapse.
4. Technical details of surgical procedure for the benefit of young gynecological surgeons is provided in this chapter.

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26 Vaginal Hysterectomy and Enterocele Repair

AG Radhika

The primary objective of surgery for vaginal prolapse is to alleviate symptoms, repair areas of weakness and undertake steps to prevent recurrence.

Principles of the Surgery

1. It is important to do a detailed examination of patient both preoperatively and also immediately before the procedure, under anesthesia. There may be cases of uterovaginal prolapse with the uterine fundus occupying a relatively normal position and elongated cervix. In such a situation, it may require application of more than one clamp on the lower pedicles and removal of uterine body needs more technical skill.
2. Sharp dissection of the anterior peritoneum to dissect bladder off uterus.
3. Opening the Pouch of Douglas under vision.
4. Three main pedicles on each side of the uterus to be secured (from below upwards)
   - Cardinal and uterosacral ligaments
   - Uterine vessels
   - Tubo-ovarian, including round ligaments
5. Excision of redundant posterior peritoneum if present; culdoplasty where indicated.
6. Colpoperineorrhaphy where required.
7. In the past, strenuous attempts were taken to make the pedicles extraperitoneal; current understanding is that this step is not a must.

Preoperative Preparation

This is similar to other gynecological procedures.

1. Detailed preoperative assessment
2. Preoperative use of antibiotics either a single agent which will cover anerobic bacteria or a combination of antibiotics can be used. It may be given at start of the surgery.
3. Rectum should be cleansed by either purgation or an enema the previous night.
4. The patient is kept nil orally from previous night of surgery.
5. Extensive cleansing of the vagina and cervix prior to the patient coming to OT is not necessary.

Position of the Patient

Lithotomy position is preferred, with both the hips and the knees being flexed. Buttocks should be right at the edge of table. Good lighting is extremely important for working in the pelvis. This may be well achieved with a fibre-optic shadowless illumination with a headlight.

Technique of Total Vaginal Hysterectomy

The external genitalia, lower abdomen till umbilicus, medial aspects of thigh, perineum and finally vagina and cervix are cleaned with betadine. Labial sutures with silk are then applied to facilitate exposure. A silk suture is used to anchor the drape to the perineal skin just above the anus to prevent contamination of the operative field by anal discharge and anchor labia minora to the skin lateral to labia majora (Fig. 26.1).

Bladder is emptied using a metal catheter at the beginning of the procedure. A careful pelvic examination, including rectovaginal examination is performed next. This step should not be omitted as it gives valuable information about previously unrecognized pelvic pathology, about the best operative approach and the degree of operative difficulty to be expected.

The size, shape and mobility of uterus should be confirmed. The direction and depth of vagina in resting

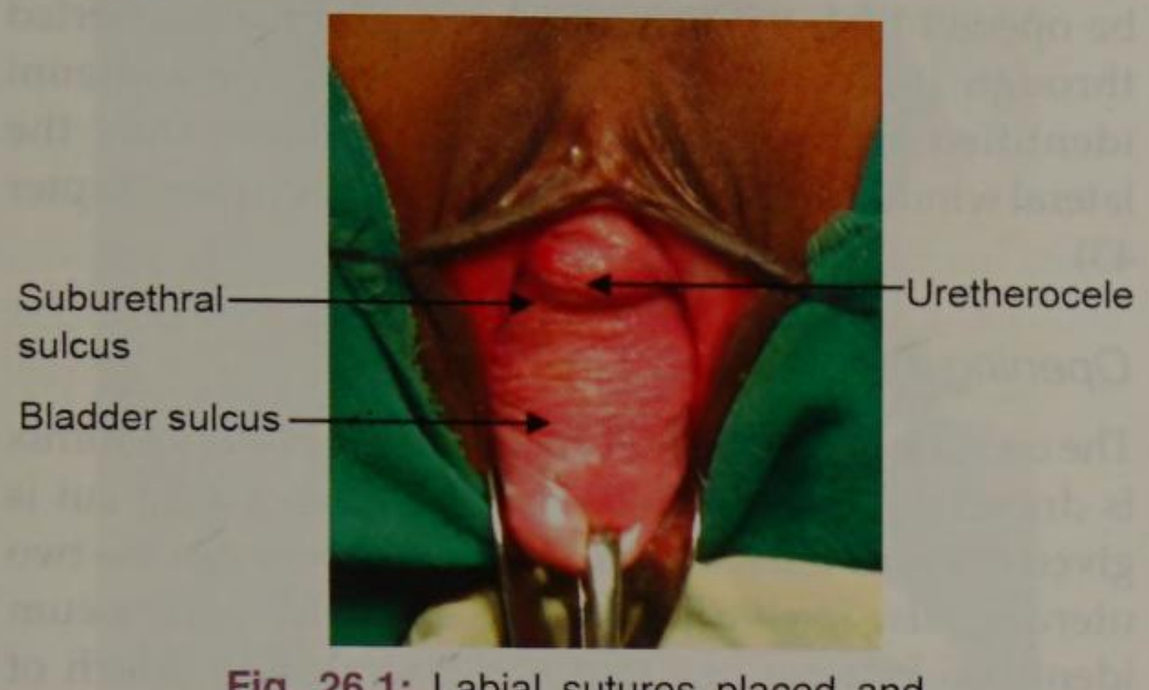


Fig. 26.1: Labial sutures placed and cervix held with volsellum

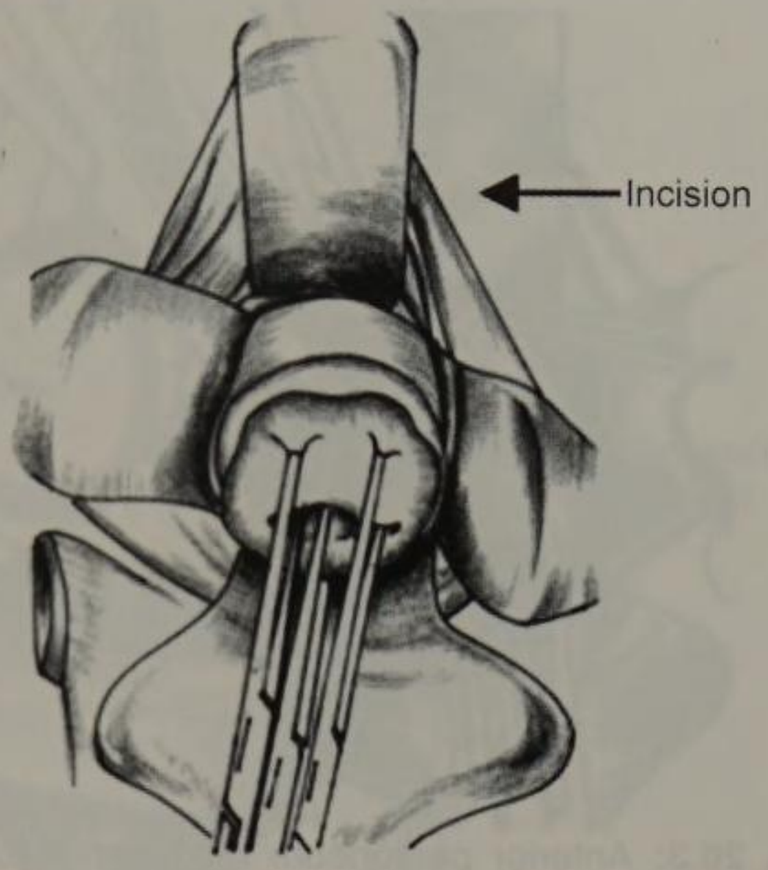


Fig. 26.2: Circular incision given on anterior vaginal wall and bladder retracted with Daver's retractor

position noted; the position and depth of pouch of Douglas (POD), supravaginal elongation of cervix, length of uterosacrals along with thickness of perineal body ascertained. In case of tight vaginal introitus or a narrow subpubic arch, an episiotomy or Schuchardt incision may be given to have adequate exposure. A weighted speculum of proper size is placed in the vagina. Lateral vaginal retractors will facilitate better exposure of the operative field. The cervix is held with a tenaculum and strongly pulled downwards into view. The instruments should preferably have curved shanks and should be long enough to keep the handles away from the introitus.

There are various means of decreasing intraoperative blood loss. 30-40 ml of 1:200,000 epinephrine or sterile saline may be injected beneath the vaginal mucosa around the cervix.[1] This facilitates dissection in the proper plane and also acts as an internal tourniquet, decreasing blood loss.

Incision

The lower limit of the bladder is identified (Fig. 26.1). A circumferential incision is made at cervicovaginal junction using scissors, scalpel or electrocautery[2] (Fig. 26.2). I have found better delineation of vaginal wall thickness with scissors than with scalpel. With proper traction on the cervical tenaculum and counter traction with a retractor, the tissue will fall away when only lightly touched with a blade. Incision can be started either anteriorly or posteriorly. To start with posterior incision is preferable so that blood trickling down can accumulate in the posterior fornix, without hindering the operative area.

Opening the Anterior Pouch

Cervix is pulled down and anterior vaginal wall incision is held with toothed dissectors. This helps in identifying vertically running cervicovesical ligament (bladder pillars). This tissue is cut with curved scissors and bladder can now easily be deflected off the anterior part of the cervix using scissors. Sharp dissection is preferable (Figs 26.3 to 26.5). The points of the curved Mayo's scissors are directed downwards or posteriorly, the handles of the scissors elevated to ensure that the tips of scissors are directed away from the undersurface of bladder. Anterior pouch of peritoneum is seen and palpated with two fingers as slippery surfaces and held with artery forceps and cut with scissors. The peritoneum should only be incised under vision since this gives a clear picture of reflection from superior surface of bladder. The bladder can then be gently elevated as it allows the ureters to be pushed upwards and outwards.

On occasions, the initial incision may inadvertently be too deep, within the connective tissue capsule of cervix (especially when the incision is too close to the cervical external os). This results in the subserosal tracking into the uterine wall and resultant difficulty in visualization of anterior peritoneal fold. It is important to identify this technical fault, bring down the uterine cover, identify the peritoneal fold and incise under direct vision.

In case of difficulty in identifying the anterior pouch (as in previous cesarean section), the posterior pouch may

Fig. 26.3: Anterior peritoneum held with forceps before incising

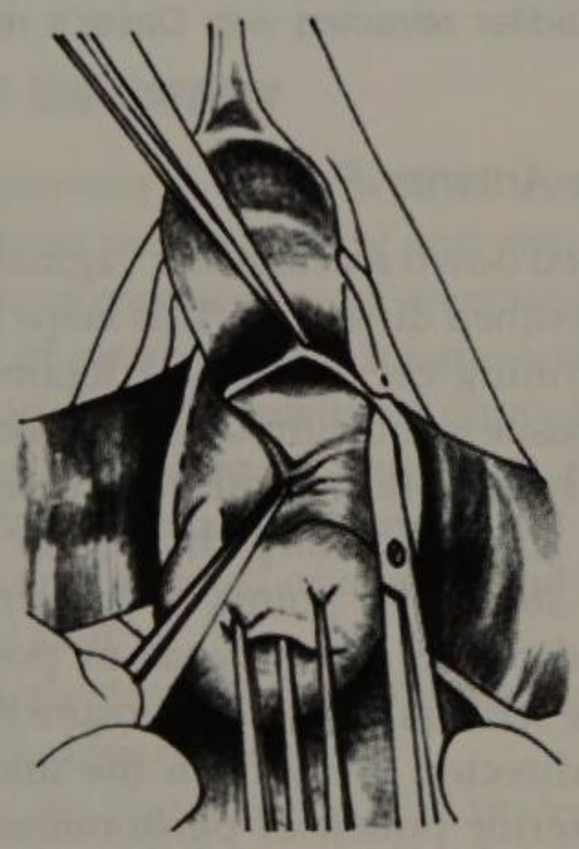


Fig. 26.4: Uterovaginal fold of peritoneum incised and surface of uterus visualized

Fig. 26.5: Exposed anterior pouch

be opened first, the index and middle fingers inserted through it into the anterior pouch, the peritoneum identified and incised under vision. Alternately the lateral window of Shirish Sheth may be used (see chapter 43)

Opening the Pouch of Douglas

The cervix is elevated and cut edge of the posterior fornix is drawn down using Allis forceps. Then a bold cut is given towards the back of the cervix in between the two uterosacrals. The vaginal edges are held, peritoneum identified between the two uterosacrals and pouch of Douglas is opened (Figs 26.6 to 26.8).

Sometimes, if the dissection has been in the wrong plane or the cul-de-sac is obliterated by adhesions, it may be advantageous to begin extraperitoneal hysterectomy by cutting and transfixing uterosacrals and the caudal portion of cardinal ligament.[3] This has the effect of bringing down the uterus along with the anterior and posterior peritoneal attachments.

Division of the Cardinal and Uterosacral Ligaments

The cardinal and uterosacral ligaments are clamped by sliding the clamps off cervix (Fig. 26.9). In case the ligaments are found to be elongated, they could be shortened at this stage. Only small bites of tissues should

Fig. 26.6: Identifying pouch of Douglas

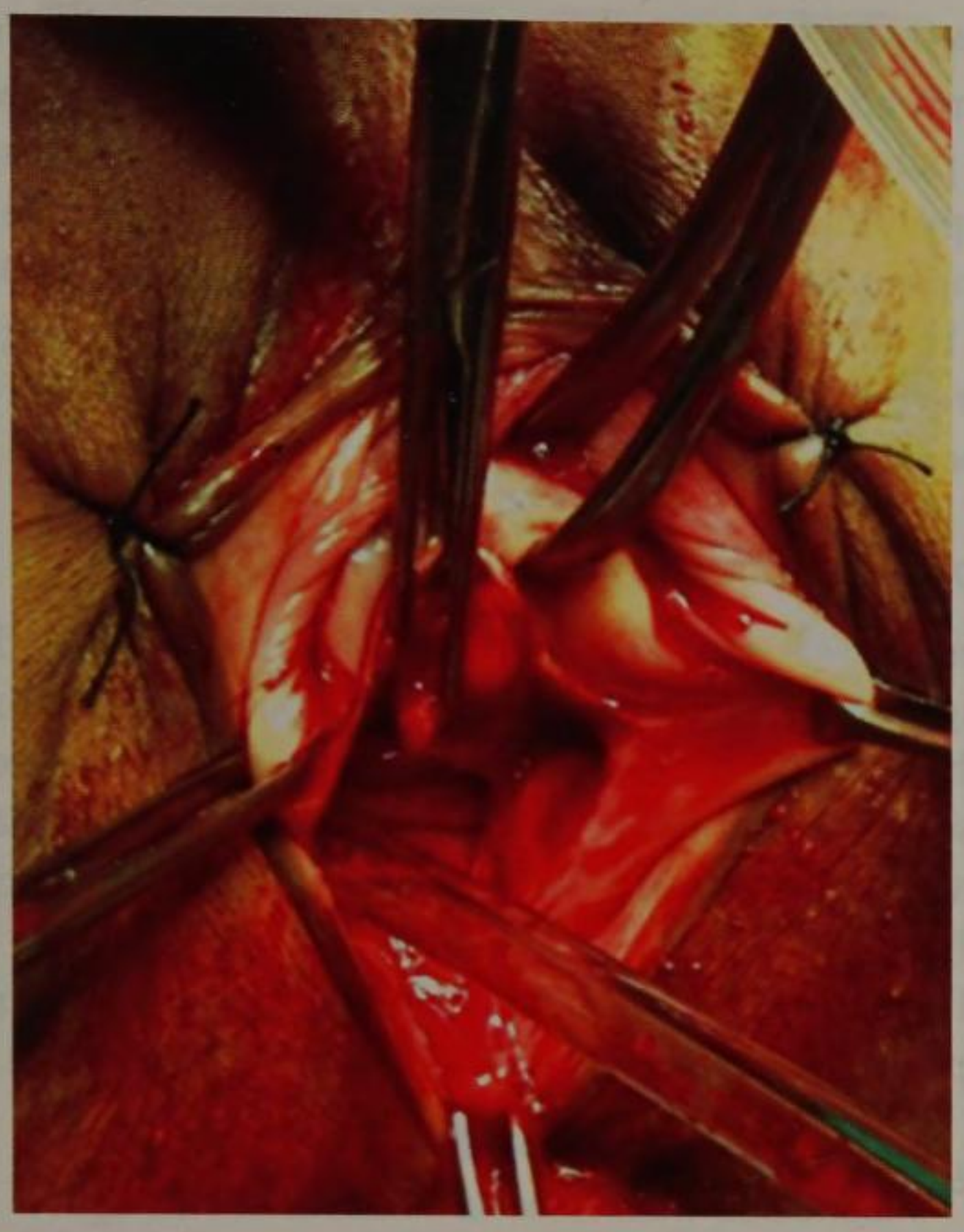


Fig. 26.7: Incising posterior fold of peritoneum

Fig. 26.8: Posterior peritoneum laid open

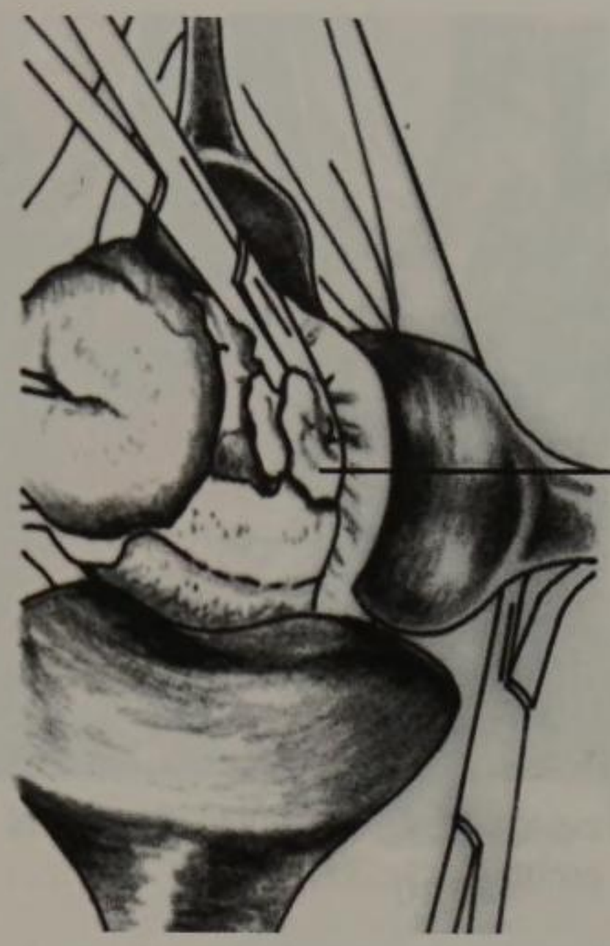


Fig. 26.9: Uterosacral ligaments identified

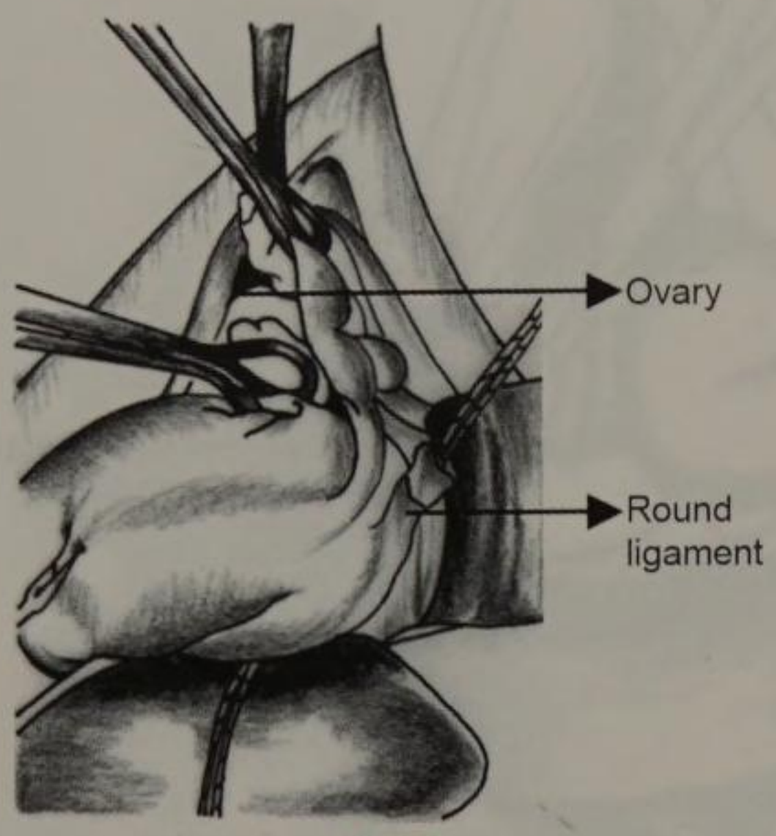
be taken. The tissue is cut to the point of the clamp and close to the uterus so that a fringe of tissue is left for more secure ligation. Transfixation stitch is applied and tightened with controlled release of the clamp. One clamp should be applied at a time due to limited operative field. The two ligatures are held long for use later in suspending the vault, one from the uterosacral ligament pedicle and one from cardinal ligament pedicle.

Division of the Uterine Vessels

The uterine vessels lie at the uterocervical junction. The uterine vessels are clamped, cut and ligated. If the anterior peritoneum has not yet been opened, it must be done before ligating the uterine vessels. The uterine pedicle contains uterine artery, vein and anterior and posterior leaf of the broad ligament peritoneum. Two successive clamps should be applied edge to edge to prevent leaving raw area that may bleed later.

Division of Tubo-Ovarian Pedicles (Figs 26.10 and 26.11)

After ligating the uterine vessels bilaterally, tubo-ovarian pedicle along with left over broad ligament tissue is clamped, cut and transfixed. This is done with two clamps to secure the pedicle, one from above and another from below to avoid slippage of tissue.



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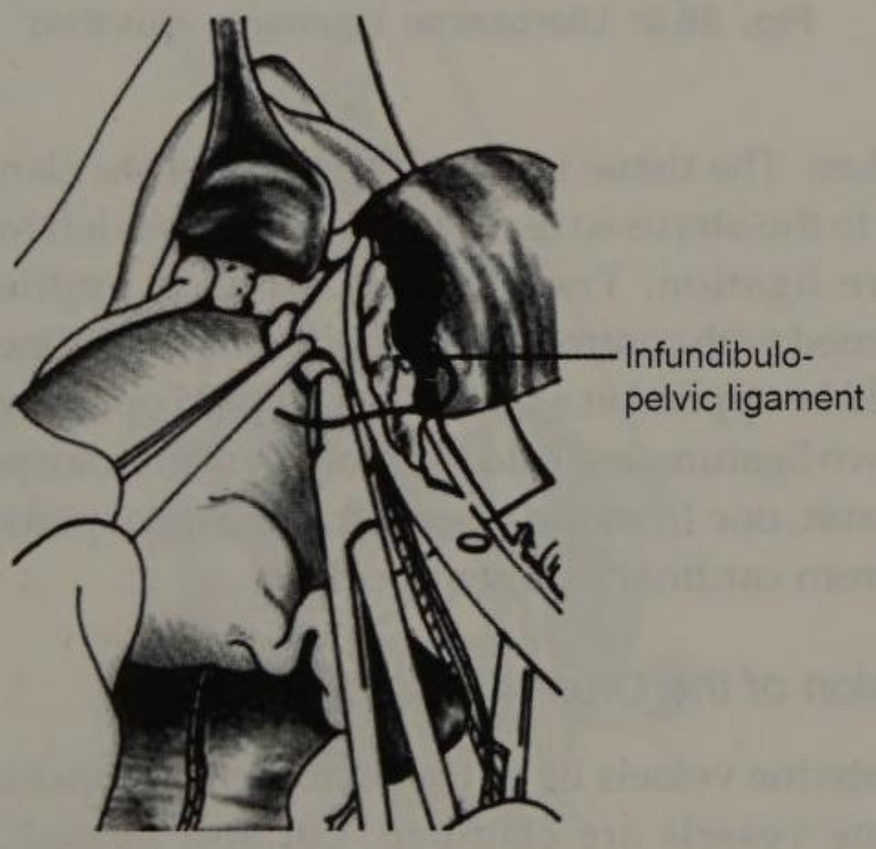

26.11

Figs 26.10 and 26.11: Ligation of cornual structures

Sometimes there can be difficulty in reaching the fundal structures.

1. In case the cervix is large, then it can be amputated across the lower uterine segment below the point of uterine vessel ligation.
2. If the uterine body is larger than expected, removing the uterine tissue by bisection, morcellation, intramyometrial coring, wedging may be tried (see chapter on Volume Reductive Non-descent Vaginal Hysterectomy). In a vaginal hysterectomy for prolapse a bisection of the cervix and uterus is all that is required for reaching fundal structures (Chapter 42).

After removal, uterus is opened and carefully examined. The tubes and ovaries should be inspected and palpated. The ovaries may be removed at this stage by applying a gentle traction on tubo-ovarian pedicle and clamping the infundibulo-pelvic ligament (Figs 26.10 and 26.11) (see chapter 43 and 44). After completing the hysterectomy, all the pedicles should be carefully inspected for hemostasis.

Reperitonization

After hemostasis is assured, peritoneal closure is done using 2-0 delayed absorbable sutures extraperitonizing all the pedicles. Peritoneal closure can be done either in purse string manner or in H- shaped manner. The latter is preferred as it keeps the ovaries away from the vaginal vault.

There is no significant value of meticulous closure of the peritoneum and this step can even be bypassed.

Closure of the Vagina

Vaginal vault is closed using interrupted 1-0 delayed absorbable sutures.

Vaginal vault can be suspended using McCall's posterior culdoplasty technique (described later). It suspends the posterior vaginal fornix to the uterosacral ligaments and closes the cul-de-sac by bringing the two in the midline and thus preventing enterocele in future.

Routine packing of the vagina and postoperative bladder drainage in all cases is not required – as has been the author's experience, substantiated by other surgeons too[4]

ENTEROCELE REPAIR

Primary Enterocele Repair and Prevention

Repair of enterocele when present with uterocervical descent and prevention of occurrence of iatrogenic enterocele is described below.

Principles of Repair

1. Dissection of the enterocele sac
2. High ligation of the enterocele sac
3. Reconstruction of adequate supports for closure and support of the hernial orifice along with restoration of normal vaginal axis.

Fig. 26.12: Excision of redundant peritoneum.

During Vaginal Hysterectomy

Enterocele repair is done using *McCall's sutures.*[5]

The redundant peritoneum of the cul-de-sac is sharply mobilized off the anterior surface of the rectum and lower sigmoid and excised (Fig. 26.12). Redundant posterior vaginal wall is also removed. Depending on the size of the enterocele, one to three internal McCall's sutures are applied.

To place the internal McCall sutures, the surgeon uses his left index and middle fingers to depress the sigmoid colon down and to the patient's right. The monofilament vicryl 1-0 suture is placed deeply in the left pararectal fascia, after which the suture is continued across the front of the sigmoid colon and then in the right pararectal fascia (Fig. 26.13). Depending on the size of the enterocele one to three McCall's sutures may be placed. These sutures are tagged and are tied after the completion of the anterior colporrhaphy.

Then one to two *External McCall* sutures can be applied. The external McCall suture is applied in a more cephalad position than the internal one.1-0 delayed absorbable suture is passed through the posterior vaginal wall and peritoneum to the left pararectal fascia, continues across the front of the sigmoid to the right pararectal fascia and is brought out through the vagina, where it is tagged to be tied at a later time. Reperitonizing suture

Fig. 26.13: Identification of uterosacrals for placement of McCall's sutures

is placed most cephalad to all McCall's sutures. McCall's sutures are tied at the end, after vault closure.

Vault Prolapse (Enterocele following Hysterectomy)

Vault prolapse can occur after abdominal or vaginal hysterectomy. It can be corrected by either vaginal or abdominal route (Fig. 26.14).

Sacrospinous Colpopexy[6]

The posterior repair is commenced as usual with the incision continued up to the vaginal vault. The redundant vaginal skin is removed. The enterocele sac is identified, isolated and removed. Then patient's right pararectal space is bluntly dissected in a posterolateral direction combined with palpation of ischial spine (Fig. 26.15). This allows visualization of sacrospinous ligament within the body of the coccygeus muscle. Proper exposure using retractors should be done. A fish hook attached to a strong absorbable suture is then passed through the sacrospinous ligament about 2 cm posteromedial to ischial spine. The application of firm traction to the suture length will test the correctness of its placement. Second reinforcing stitch should also be passed similarly. These sutures are then passed through upper edge of the posterior vagina using an eyed needle. These sutures are tightened and tied at the end of vaginal vault closure (See chapter 27 on Sacrospinous Colpopexy).

Complications of Vaginal Hysterectomy

A. Intraoperative
   a. Hemorrhage from any of the pedicles due to improper ligation, due to laceration, avulsion of pedicles, peritoneum or from vaginal edge.
   b. Injury to adjacent viscera

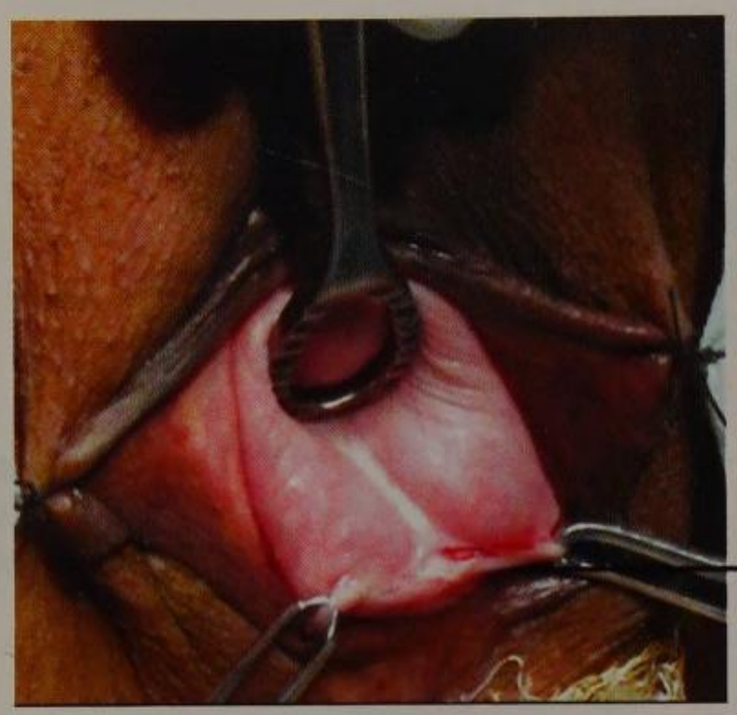

Fig. 26.14: Vault prolapse posthysterectomy

Fig. 26.15: Pararectal space

Management of Bladder and Rectal Injuries during Vaginal Hysterectomy

Bladder Injury

Once bladder injury has been recognized, it may be better to complete the hysterectomy procedure and then repair it.

Steps of Repair

1. Adequate and complete exposure of laceration.
2. The two ends of laceration are grasped with Allis forceps.
3. Complete visualization of bladder mucosa in the defect.
4. Closure of defect beginning and completing beyond the corners with 3-0 delayed absorbable sutures

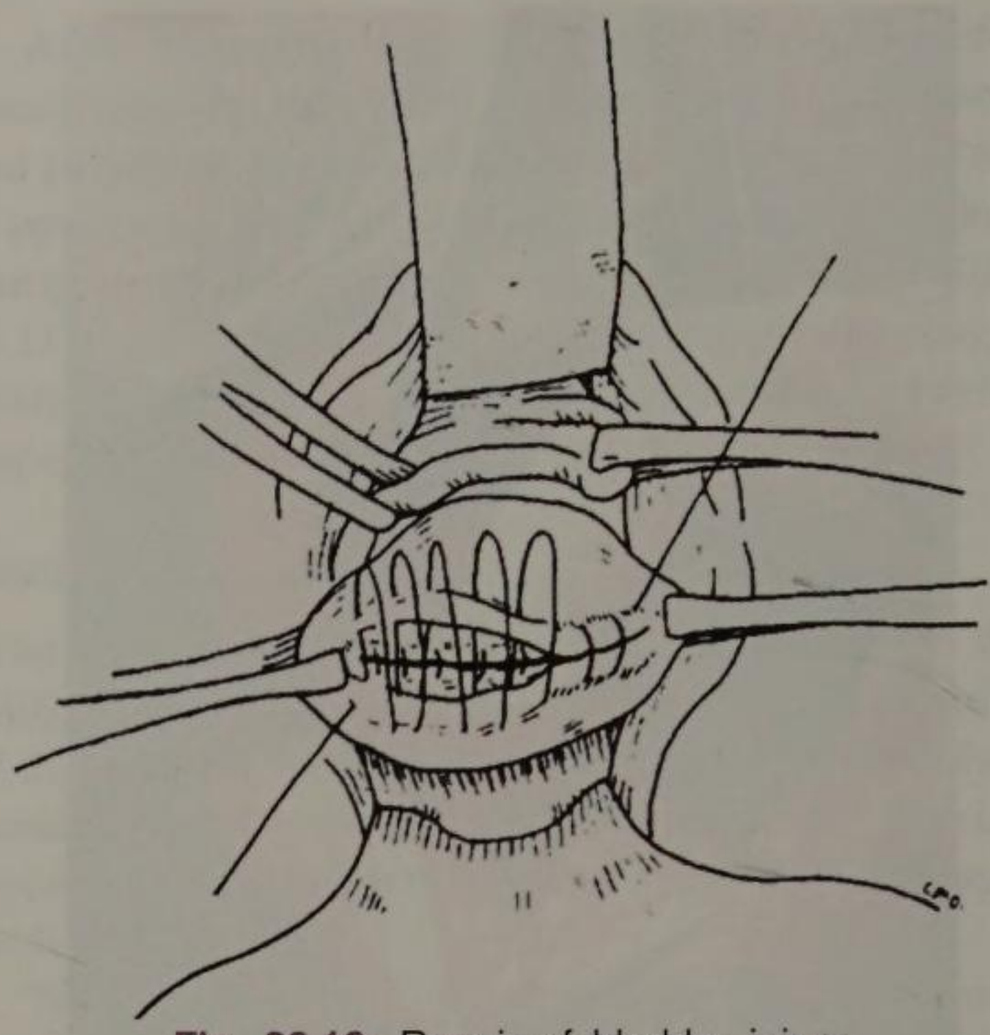

Fig. 26.16: Repair of bladder injury

(vicryl) (Fig. 26.16); full thickness of the wall may be taken.
5. Second inverting layer with same suture.
6. Postoperative catherization for 7 days.

Rectal Injury

Though rectal injury is unusual, it may occur at entry to posterior pouch with factors leading to obliteration of pouch, e.g. pelvic inflammatory disease, endometriosis. The steps of repair are similar as in bladder injury with 3-0 delayed absorbable sutures. The repair is done as soon as detected. In case of minor injuries, hysterectomy may be completed.

The procedure of hysterectomy may be postponed in case of vaginal soiling with stool.

Early Postoperative Complications

1. Prolonged surgery may result in postoperative pain in the back and lower limbs due to nerve compression due to edema
2. Vague abdominal and perineal pain
3. Urinary retention
4. Postoperative ileus – uncommon following vaginal surgery especially with regional anesthesia
5. Fecal impaction
6. Infection – this may involve the wound, urinary tract, chest infection, phlebitis
7. Secondary hemorrhage

Late Complications

1. Prolapse of fallopian tube. This may be managed by removal of the entire tube after opening the vagina again or only the removal of the prolapsed part of tube with a local anesthetic spray (See chapter 37 on Fallopian Tube Prolapse).
2. Vault prolapse
3. Fistula (vesical/rectal) if injury during surgery was missed.

CONCLUSIONS

Vaginal hysterectomy for prolapse is a simple procedure. While removal of the uterus is the simplest step, identification of the fascial planes and structures for strengthening vaginal supports requires expertise and technical finesse. The main aim of repair following hysterectomy is to provide a good vaginal suspension, maintain an adequate vaginal depth to prevent future urinary or sexual problems and to maintain the normal axis and direction of vagina without distorting the intra-abdominal anatomy.

Key Points

1. Detailed preoperative workup of the patient is important to plan the nature of surgery
2. Planes are better dissected by sharp dissection
3. The anterior and posterior pouches should preferably opened under vision
4. Routine suspension of vagina and closure of uterosacral hiatus by McCall's culdoplasty is good surgical practice
5. Large primary vaginal prolapse and vault prolapse are best anchored by sacrospinous colpopexy

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27

Sacrospinous Colpopexy

KC Singh, SD Barman

Introduction

Pelvic organ prolapse is a quality of life disorder and surgical treatment should be considered when patients' symptoms are bothersome enough that they wish to accept the risks, inconveniences and complications that may associate with the procedure. Important consideration is that there may be differences between patient and gynecologist's perceptions of need for treatment and its outcome. Therefore, it is important to understand woman's goals for treatment. Surgery can restore vaginal anatomy and relieve symptoms in many women who opt for surgical repair. However, improvement in objectively measured outcomes after surgery does not always correspond to patient satisfaction.

The vaginal route is unique to gynecologic surgeons and offers the advantages of a quick recovery and few complications. Thus, most of the gynecologists would consider vaginal approach at the first outset. The objectives of vaginal repair are correction of pelvic floor relaxation and restoration of vaginal anatomy. This requires identification and correction of all the defects, which are paravaginal, anterior and posterior vaginal wall defects and apical defects. The principles of surgery are to (1) plicate pubovisceral muscles in order to decrease the genital hiatus (2) repair fascial defects by plicating endopelvic fascia and ligaments (3) strengthen levator plate either by plication and/or fixing vault to the spine or sacrum. These principles are applied in the various vaginal surgical procedures in different types of POP.

Anterior Vaginal Wall Prolapse

Traditionally anterior colporrhaphy has been used to repair anterior vaginal wall prolapse. The essentials of the procedure are to reduce the prolapse and repair the fascial (pubovesicocervical fascia) defect by plication. Recent trend is to use a mesh to supplement the repair and it is essential in those patients with large facial defect to prevent recurrence. Tension-free vaginal tape is recommended in situations where there is accompanying stress incontinence.

Posterior Vaginal Wall Prolapse

The conventional posterior colporrhaphy includes repair of both rectocele and enterocele vaginally. The principal aim is to strengthen the pubovisceral portion of levator ani muscles. As in repair of anterior vaginal wall prolapse, use of mesh is recommended in addition to plication of the pubococcygeous muscles. Care must be taken not to cause narrowing of vaginal introitus to prevent subsequent dyspareunia.

Apical Prolapse

Traditional procedure is vaginal hysterectomy with pelvic floor repair (anterior colporrhaphy and posterior colpoperinorrhaphy). However, in advanced prolapse (stage III onwards), plication of levator ani muscles is not enough to elevate the sagging levator plate and it requires additional support such as colpopexy to sacrum or sacrospinous ligament. Thus transvaginal sacrospinous colpopexy procedure is a useful adjuvant when treating marked uterovaginal prolapse and in contrast to abdominal approach allows the surgeon to correct coexistent cystocele and rectocele.

The removal of uterus is not mandatory for the correction of the disorder and comparable success rates have been reported between sacrospinous cervicocolpopexy with uterine conservation or vaginal

hysterectomy concomitant with sacrospinous colpopexy.[1,2] Women who do not desire future vaginal intercourse and/or are in poor general health may consider an obliterative procedure, such as colpocleisis. Colpocleisis is highly effective with low morbidity for correcting apical prolapse in such women.

Use of Mesh

Use of graft placement in surgical repair of pelvic organ prolapse is steadily rising, but controversy exists regarding the optimal choice of material. As of now, type I or macroporous synthetic mesh is widely used and it has the advantage of being readily available, cost-effective, and consistent in quality, but may present with significant complications, including infection and erosion. In contrast, allografts/xenografts provide naturally occurring biomaterials that may undergo desired remodeling, but *in vivo* tissue response is still not fully understood.[3] During mesh insertion, one should be careful about overcorrection and it should never be inserted under tension because all meshes contract to certain extent, maybe upto 20%.

Mesh erosion is one of the complications leading to failure of the procedure. However, Shah DK, et al[4] in a retrospective analysis of 29 patients who underwent transvaginal sacrospinous fixation using mesh material reported an effective method till 2 years of follow up. Cochrane database[5] revealed that for the anterior vaginal wall prolapse, standard anterior repair was associated with more recurrent cystoceles than when supplemented by Vicryl mesh overlay (RR 1.39, 95% CI 1.02 to 1.90) but data on morbidity and other clinical outcomes were too few for reliable comparisons.

Sacrospinous Colpopexy

This surgery is the best-studied vaginal procedure for treating apical prolapse and its routine use is indicated in pelvic organ prolapse with component of apical prolapse of stage III onwards. It offers support to the upper vagina minimizing risk of recurrent prolapse. The additional advantage of this surgery is that vaginal length is maintained. Anatomic cure rates after sacrospinous ligament suspension range from 63 to 97 percent[6] with anterior vaginal wall recurrence as high as 37 percent.[7] Therefore, an effort should be made to detect and repair anterior wall defects when apical prolapse repair is done.

Randomized trials have shown that sacrospinous colpopexy is slightly inferior to abdominal sacrocolpopexy in anatomic restoration, but results are similar in patient satisfaction. Cochrane database (2004)[5] identified fourteen randomized controlled trials evaluating 1004 women to determine the effects of surgery in the management of pelvic organ prolapse. Abdominal sacral colpopexy was better than vaginal sacrospinous colpopexy in terms of a lower rate of recurrent vault prolapse (RR 0.23, 95% CI 0.07 to 0.77) and less dyspareunia (RR 0.39, 95% CI 0.18 to 0.86), but the trend towards a lower re-operation rate for prolapse following abdominal sacrocolpopexy was not statistically significant (RR 0.46, 95% CI 0.19 to 1.11). However, the vaginal sacrospinous colpopexy was quicker and cheaper to perform and women had an earlier return to activities of daily living. These benefits must be balanced against a longer operating time, longer time to return to activities of daily living and increased cost of the abdominal approach.

More recently, in an observational study[2] a high long-term success rate was reported in 305 women who underwent transvaginal sacrospinous colpopexy (117 with hysterectomy and 182 without) with 4% recurrent vault prolapse. Symptomatic cystocele occurred in 15 patients (5%). There were six recurrences of rectocele (2%) and there was no enterocele recurrence. Sexual function was maintained in all sexually active women and 43% reported improvement in sexual function.

Sacrospinous colpopexy is generally performed unilaterally. Some surgeons have proposed bilateral colpopexy, although the value of this modification has not been proven.[8] It is dependent upon adequate vaginal length and depth. David-Montefiore E, et al[9] in 2006 reported feasibility of bilateral SSLF in a retrospective longitudinal study of 51 women with stage III or IV genital prolapse. The patient satisfaction rate was 93% with an acceptable intra- and post-operative complication rates.

Procedure

Unilateral transvaginal sacrospinous colpopexy is performed on the right side because the normal anatomic lateral curvature of rectum gives more space on this side at the level of sacrospinous ligament.

It is essential to be conversant with the anatomy of sacrospinous ligament and its relation with other structures (Fig. 27.1) in order to understand the procedure. Before starting the procedure, the surgeon must ensure that the vagina is long enough to reach the sacrospinous ligament without a suture bridge. Short

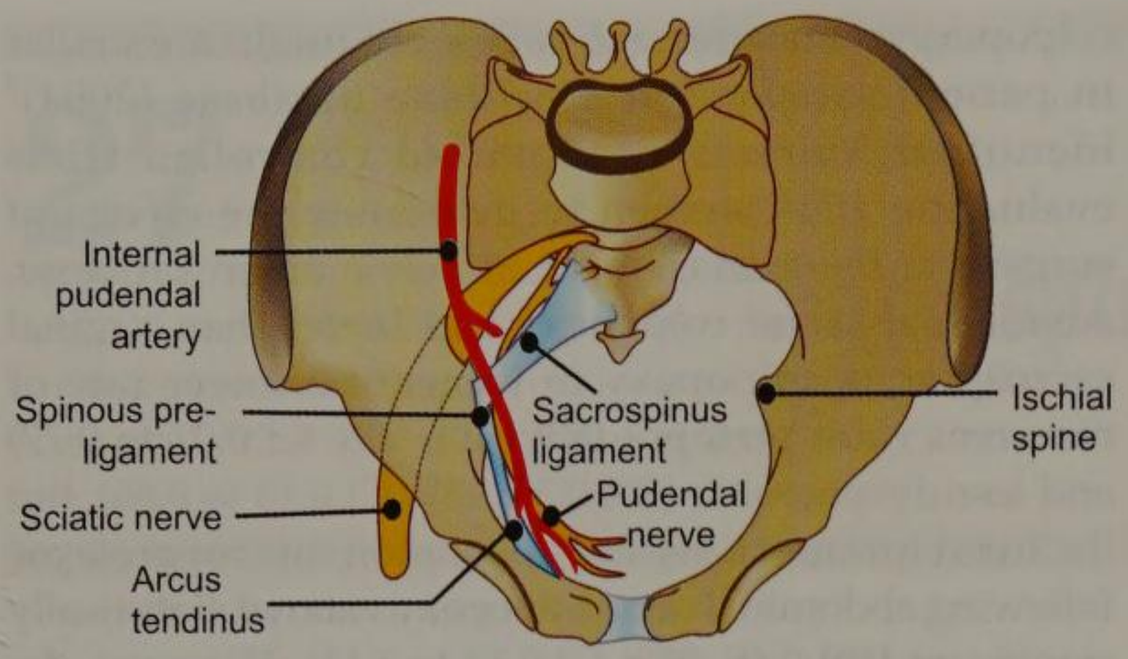

Fig. 27.1: Schematic diagram of anatomic relation of right sacrospinous ligament

vagina with a suture bridge is one of the causes of failure of this procedure. Therefore, some surgeons do not attempt if vagina is shortened from previous vaginal surgery. Even though it is essentially similar to perform this procedure with or without hysterectomy, it will be described separately as follows.

When Combined with Vaginal Hysterectomy

The sequence of repair should be: vaginal hysterectomy, repair of anterior vaginal wall defect and any associated stress urinary incontinence, and then sacrospinous colpopexy. This is combined with repair of posterior vaginal wall prolapse. Thus perineal body and vaginal introitus should be assessed to decide how much repair is to be done. It is a good practice to place a marking suture on the vaginal apex where the ligament is to be fixed.

Transverse perineal incision is made on the junction between perineal skin and vaginal mucosa. A midline vertical incision is made on the posterior vaginal wall from the vault which is still open till the midpoint of the transverse perineal incision. Vaginal mucosa is separated from the underlying rectum.

Separation of vaginal mucosa on the right side is deepened to expose the rectovaginal space with blunt but gentle dissection preferably with fingers (Fig. 27.2). It is very important that during this dissection the direction should be towards the pelvic wall taking care not to give much pressure on the rectum to prevent injury. The rectum is gently pushed medially, and the rectal pillar is perforated. In primary surgery this is surprisingly easy.

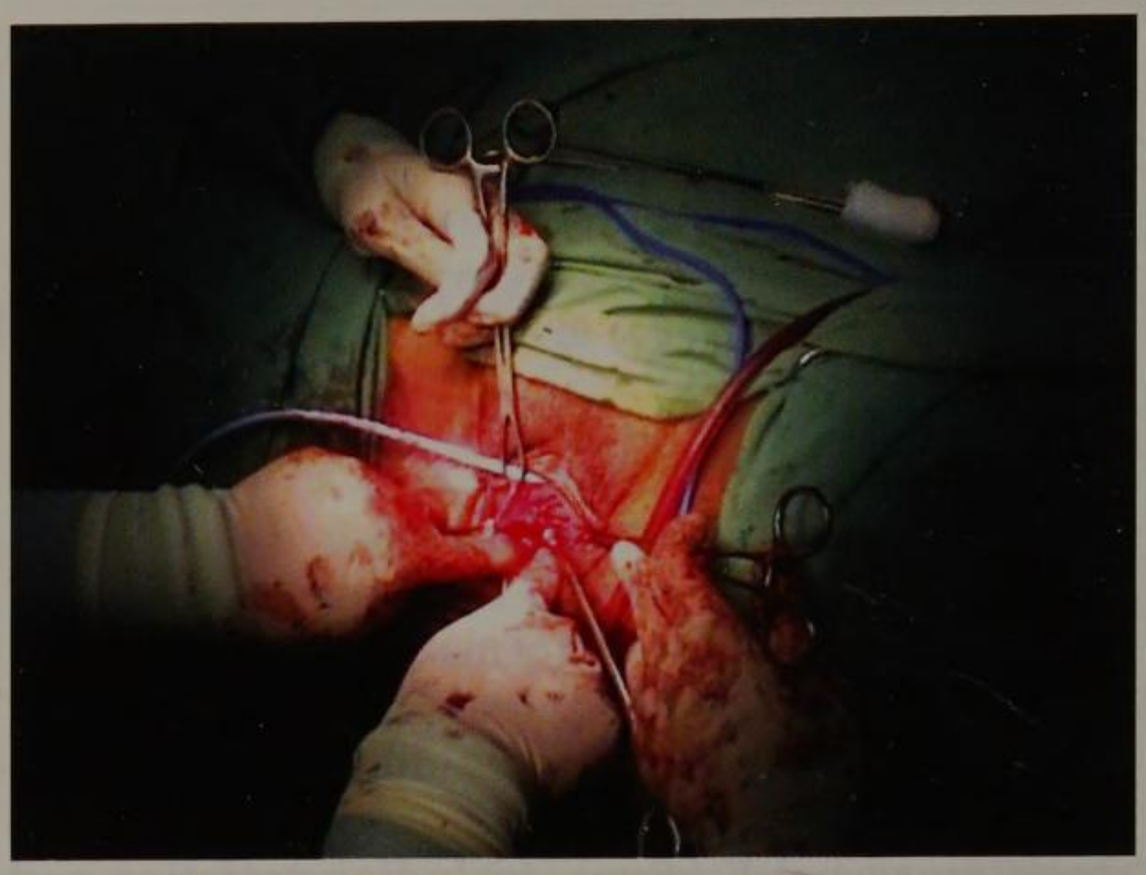

Fig. 27.2: Dissection of right paravaginal space

Still with the fingers the perirectal space should be enlarged and deepened till the pelvic side wall is easily felt and ischial spine is palpated. Sacrospinous ligament runs from ischial spine to lateral border of sacrum and it can be visualized with the help of long right angled retractors (Fig. 27. 3) placed laterally to protect the pudendal neurovascular bundle and medially the rectum.

Placement of Stitch on the Sacrospinous Ligament

Placement of suture on sacrospinous ligament should be done with vision. Proper visualization may be facilitated by another of long right angled retractor or single bladed

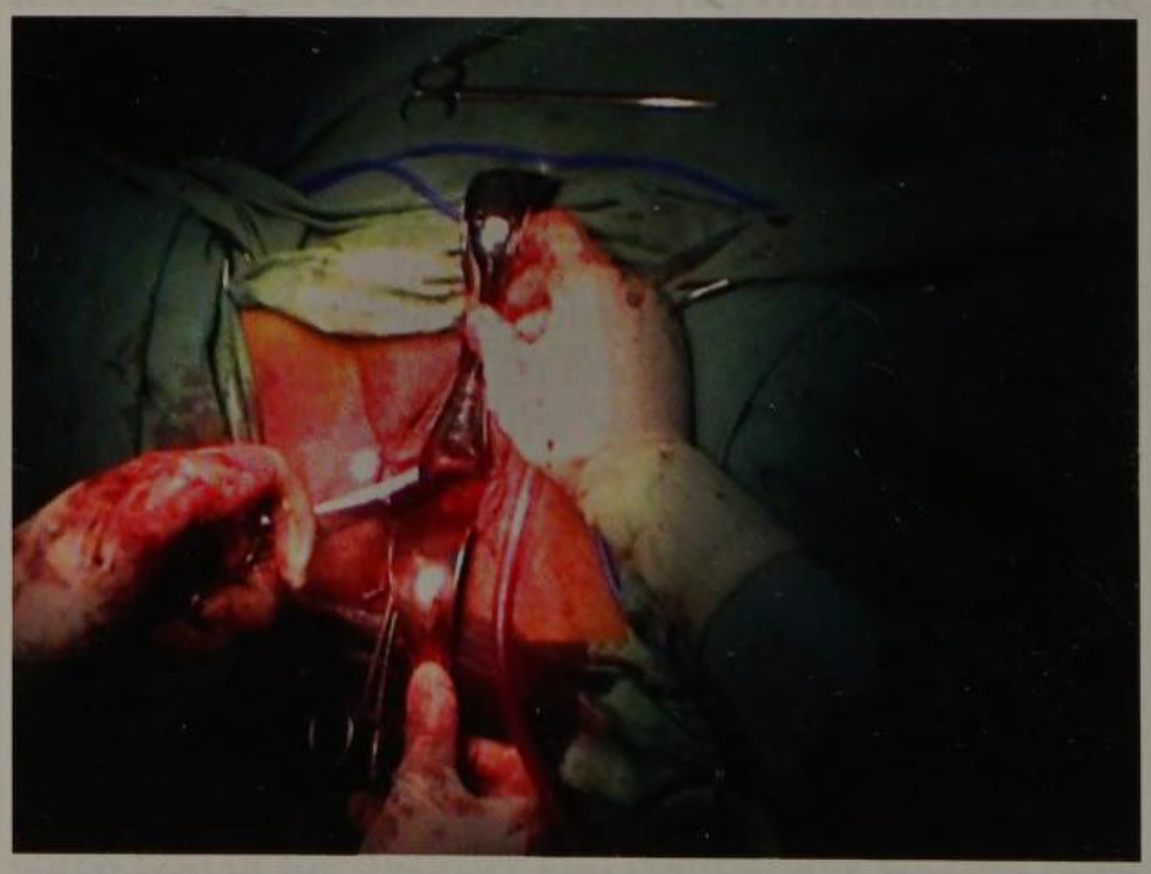

Fig. 27.3: Right paravaginal space deepened till sacrospinous ligament

Sim's speculum, which may be rotated to retract any tissue obliterating the view. Proper adjustment of light is necessary. Under vision the ligament is caught at about 1 to 2 cm medial to the tip of ischial spine with a long Allis forceps and traction is applied to confirm a proper grip.

It requires some technique to take the stitch as the available space is limited for free movement of needle holder. There are now needle holders specially designed for this purpose. The basic principle is that needle is held in line with the holder, not across as in conventional needle holder. Using this principle any needle holder, preferably a curved one can be used. We have been using normal needle holders and have experienced ease with this to apply the suture. The needle is held in line with the holder and angle is adjusted so that it can take a proper bite at the place where Allis forceps has been applied. This can be facilitated by traction on the Allis forceps. In order to confirm proper placement of suture, traction is made on the suture and one can appreciate the strength of the placement. Most gynecologists prefer to take two sutures on the ligament. Polyglycolic suture (Vicryl) No. 1 is used. The ends of these sutures are left long and sutured at the vaginal vault without tying. Nonabsorbable sutures such as Prolene are preferred by some surgeons but if these are used they should be in the muscularis on the undersurface of vaginal mucosa so that the knots are not exposed outside.

Colpoperinorrhaphy is done along with repair of other fascial defects in the usual manner taking care not to excise too much of vaginal mucosa and leave an adequate length of vagina. The vaginal skin is closed and finally, the sacrospinous sutures are tied that will anchor the vault high inside on the right side. It is a good practice to pack the vagina tightly overnight to decrease the risk of bleeding.

Posthysterectomy Apical Prolapse

A vertical incision is made on the anterior vaginal wall and it is continued on the posterior vaginal wall. Vaginal mucosa is separated and enterocele is identified. It is not mandatory to open the enterocele. But many surgeons prefer to open the enterocele to excise the sac. Here extreme care is necessary to avoid bladder and rectal injury. Sharp dissection is to be done and identification of bladder can be assisted by metal urinary catheter and rectum by inserting a finger in the rectum.

Anterior wall prolapse is first repaired. Then right rectovaginal space is dissected. Unlike in primary surgery it should be done with sharp and blunt dissection taking care not to injure the rectum. Long artery forceps can be used to dissect out the space. However, it is always preferable to dissect wherever possible with fingers. Once it is dissected, the space is enlarged and deepened till the pelvic side wall is easily felt and ischial spine is palpated.

Subsequent steps of placement of sutures on sacrospinous ligament are the same as above. Enterocele is repaired by plicating the utersacral ligaments. However, many a time it is difficult to identify attenuated uterosacral ligaments and plication of tissues around the ligament is done.

Excess vaginal mucosa is excised taking care to leave an adequate vagina. This should be ascertained by repositing the prolapse and assessing the length. Colpoperinorrhaphy is done in usual manner and the sacrospinous sutures are firmly tied.

Complications

The complications are damage to the surrounding organs, which are bladder, rectum, pudendal vessels and nerve, the sciatic nerve. Fortunately, they are uncommon. We have not experienced any of these complications in over 25 consecutive patients who have had this procedure (unpublished data). Similar results were reported in the literature.[10] However, Estrade JP, et al[11] in a retrospective study involving 277 reported one intraoperative bleeding, four rectal injuries, six postoperative vaginal hematomas and two abscesses. Long-term symptoms were perineal pain, sciatic neuralgia, and dyspareunia. The procedure was combined with the anterior vaginal repair in 137 patients, incontinence surgery in 31 patients, vaginal hysterectomy in 137 patients and levator myorrhaphy in 203 patients. In another retrospective study by David-Montefiore E, et al[12] they performed the procedure in 107 under digital control and in 88 cases under visual control. The major complications were represented by 3.6% of bladder injury, 0.5% of uretero-vaginal fistula, 0.5% of vascular injuries, 0.5% of thromboembolic. They stated that these events were secondary to the combined procedures and not to the colpopexy itself. The only specific complication was a vascular injury occurred when performed the procedure under digital control.

Fig. 27.4: Right sacrospinous ligament being held by an Allis forceps

Intraoperative hemorrhage from laceration of the pudendal vessels can be prevented by careful dissection and placement of suture through the sacrospinous ligament in the 1-2 cm medial to its insertion in the ischial spine. This kind of hemorrhage is best treated by tightly packing the ischiorectal fossa and waiting for hemostasis to occur.

CONCLUSIONS

Sacrospinous colpopexy is the best-studied vaginal procedure for treating apical prolapse and its routine use is indicated in pelvic organ prolapse with apical prolapse of stage III onwards. It offers support to the upper vagina thus minimizing risk of recurrent prolapse.The additional advantage of this surgery is that vaginal length is maintained. Anatomic cure rates after sacrospinous ligament suspension range are high but anterior vaginal wall recurrence is also high. Therefore anterior wall defects must be detected and repaired with apical prolapse repair preferably with a mesh.

Key Points

1. Unilateral transvaginal sacrospinous colpopexy is performed on the right side because the normal anatomic lateral curvature of rectum gives more space on this side at the level of sacrospinous ligament.
2. It is essential to be conversant with the anatomy of sacrospinous ligament and its relations with the other structures in order to understand the procedure.
3. Before starting the procedure, the surgeon must ensure that the vagina is long enough to reach the sacrospinous ligament.
4. The procedure can be performed with or without hysterectomy.
5. It is important that the rectovaginal space be created with blunt but gentle dissection with fingers. During dissection direction should be towards the pelvic wall taking care not to injure rectum. The rectum is gently pushed to the left and the rectal pillar is perforated.
6. The perirectal space is deepened till the pelvic side wall is easily felt and ischial spine is palpated.
7. Sacrospinous ligament runs from ischial spine to lateral border of sacrum and it can be visualized with the help of long right angle retractors.
8. Placement of suture on sacrospinous ligament should be done under vision through the sacrospinous ligament 1-2 cm from its insertion in the ischial spine.
9. Intraoperative hemorrhage rarely occurs with proper placement of sutures and is best treated by tightly packing the ischiorectal fossa.

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28

Posthysterectomy Vault Prolapse

Sumita Mehta

INTRODUCTION

There are few maladies in feminine life more disturbing to its quality than that of massive eversion of vagina. More women are living longer and there is much interest in maintaining a self image of feminity and the capacity for sexual intercourse beyond the menopause. The true incidence of vaginal vault prolapse is unknown. The reported incidence of posthysterectomy vaginal vault prolapse varies between 0.2% and 1%.[1] It may be of various degree, with or without recurrence of the other forms of genital prolapse such as cystocele, enterocele and rectocele. The main goal of any procedure aimed at suspending the vaginal vault should be to suspend as near as possible to its normal anatomic position. Many operations have been described for suspending the prolapsed vaginal vault and there is no general consensus on which is the best procedure. The procedure that the surgeon ultimately chooses is influenced by many factors like the patient's age, state of health, anticipated outcome, sexual activity, and overall state of the tissues.

Anatomy

There is multiplicity of anatomic supportive defects that gives rise to the combinations of clinically significant damage encountered in patients with posthysterectomy vaginal prolapse.

Delancy described the anatomy of vaginal vault prolapse in term of three levels of supports[2] (Fig. 28.1).

Level I which involves the support of the upper vagina and cervix or the vaginal cuff (in hysterectomised patients) by the cardinal uterosacral ligament complex.

Level II denotes the lateral support of the mid vagina to the arcus tendineus fascia (white line).

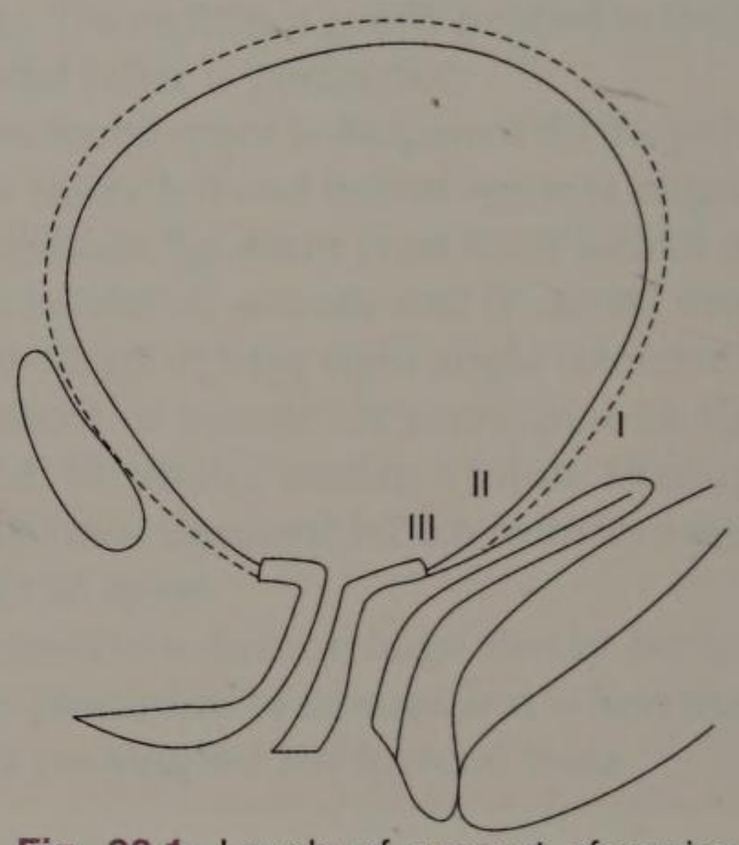


Fig. 28.1: Levels of support of vagina

Level III is represented by the fusion of tissue along the base of the urethera and the distal rectovaginal septum to the perineal body. Level I support is considered most important in maintaining adequate overall pelvic support.

The damage to these support levels may occur singly or in any combination. It is important to identify each site of damage preoperatively so that suitable remedial steps can be incorporated in the reconstructive surgery.

Pathophysiology

Posthysterectomy vaginal vault eversion is related to the adequacy of support of the vaginal vault. Prevention of eversion is directly related to reorganization of the strength and length of the patient's uterosacral ligaments at the time of surgery. If they are long and strong, they should be shortened before they are attached to the vaginal vault. A wide vaginal vault should be surgically narrowed, and the cul-de-sac obliterated or any

enterocele excised. Initially there is eversion of a poorly supported vaginal vault, with coexistent enterocele in 60% to 70% of patients. At first it may be partial with early small displacement type of cystocele (which often disappears) with replacement of the vault. As the vault descends further, it brings with it more of bladder as a larger cystocele.

Also, it is very important to preserve the vaginal depth during hysterectomy. [3] If, after removal of uterus, the vagina is well supported and sits upon an intact levator plate, intra-abdominal pressure applied to vagina will be countered by pressure in the opposite direction from the pelvic diaphragm. The vagina will be compressed between these two pressures and remain in place. But, if the vagina is short after hysterectomy, and ends anterior to the levator plate, intra-abdominal pressure will be exerted in the axis of the vagina and will cause it to telescope and to become even shorter[4] (Figs 28.2A and B).

As the prolapse progresses to total vaginal eversion, the dilating wedge like effect of the prolapse on the levator ani increases the width of the genital hiatus and accentuates the defect in the pelvic diaphragm and perineal body making rectocele and perineal body defect become evident.[5]

Methods of Surgical Treatment

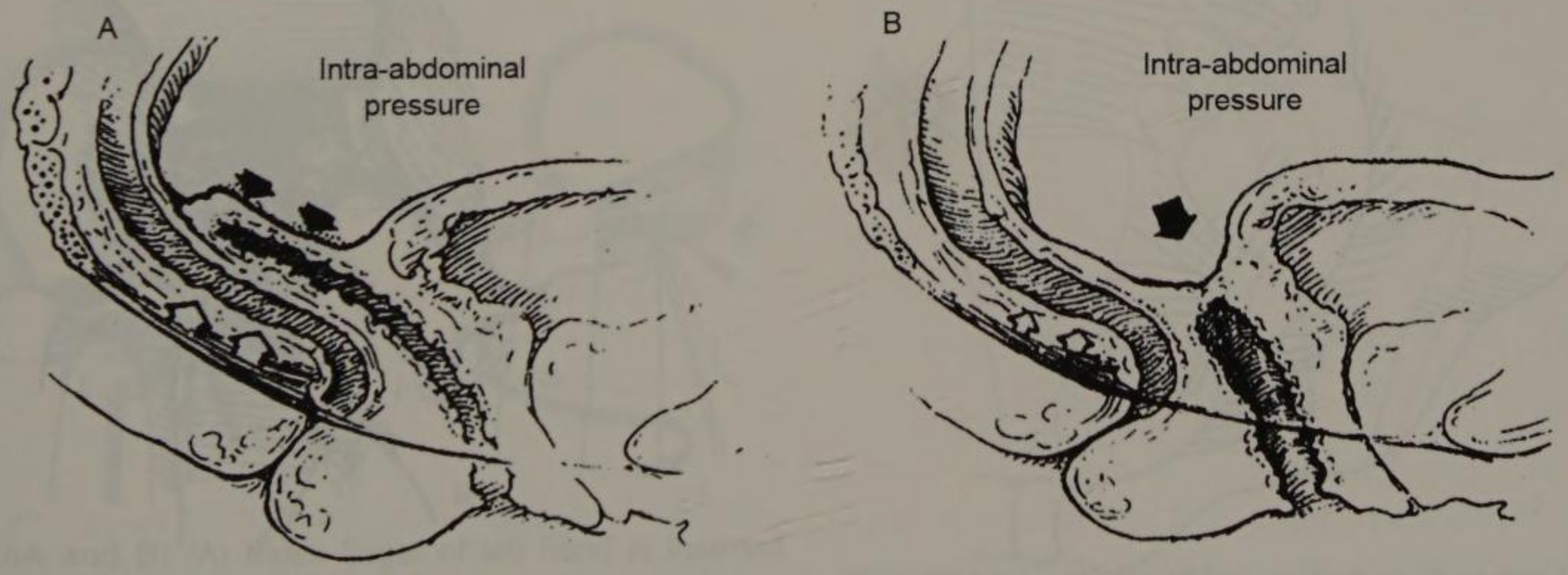
1. Transvaginal Sacrospinous Colpopexy.
2. Bilateral Iliococcygeal fixation.
3. Bilateral Uterosacral suspension.
4. Vaginosacral colpopexy.
5. Intravaginal slingoplasty.
6. Transvaginal mesh repair.
7. Lefort colpoclesis or colpectomy.

There are 5 goals of reconstructive surgery:

1. Relief of the symptoms.
2. Restoration of the anatomic relationships between the pelvic organs.
3. Restoration of the horizontal vaginal axis and of normal vaginal length.
4. Restoration of normal depth bowel and bladder function.
5. Maintenance of the potential for satisfactory sexual function.

Preoperative Workup

1. In taking the patients' history one should carefully note whether there was a previous urinary stress incontinence when the patient was younger and which symptoms were relieved as the vaginal vault descended (suggesting a kinking of urethra coincident with prolapse).
2. A standard preoperative laboratory evaluation is done to screen for anaemia, metabolic abnormalities and clotting problems. The operation usually involves elderly patients and prolonged Trendelenburg position with legs elevated in stirrups so special attention is given to the patients with cardiac or pulmonary disease and prophylactic anticoagulation therapy should be considered.
3. A urine analysis and culture is done to rule out infection.



Figs 28.2A and B: (A) Long posthysterectomy vagina in which the vaginal vault is supported above the intact levator plate, (B) Vault of shorter posthysterectomy vagina ends anterior to intact levator plate

4. Urodynamic studies are mandatory. Incontinence could be present due to stress incontinence, detrusor or urethral instability or due to low urethral pressure.

Transvaginal Sacrospinous Colpopexy

This is a very effective transvaginal operation that re-establishes a horizontal vaginal axis and returns the vagina to the hollow of the sacrum. It consists of sewing the vagina to the sacrospinous ligament. This operation was first described in principle by Zweifel in 1892.[6] Later, White described suture of vagina to each arcus tendinous.[7] Sedrel sewed the vagina to sacrospinous ligament.[8] More recently, this approach has been reported by Richter. [9,10]

Anatomy

The sacrospinous ligament is an aponeurosis located within the substance of each coccygeus muscle in the lateral wall of para-rectal space which extends from each ischial spine to the lower portion of the sacrum.

The pudendal nerve and vessels lie directly posterior to the ischial spine (Fig. 28.3). To avoid trauma to these structures the surgeon should place the fixation stitches through the sacrospinous ligament one and one half to two finger breadths medial to ischial spine.

Surgical Steps

1. The initial surgical incision is made through the perineum and posterior vaginal wall to enter the rectovaginal space.
2. Any enterocele is identified and opened. The neck of the enterocele sac is carefully palpated for any usable uterosacral ligament strength. The neck of the sac is closed, the sac is excised and the operator proceeds with the sacrospinous colpopexy.
3. The rectum is carefully displaced by an appropriate retractor to the patient's left and the right ischial spine is carefully palpated.
4. For proper suture placement, the surgeon must create a window through the descending rectal septum over the ischial spine. This window can be made by blunt penetration with the finger, by closed tips of curved Mayo scissors or by a sharp pointed hemostat, as the resistance of the tissue demands (Fig. 28.4). The sacrospinous ligament coccygeus muscle complex is palpated and usually can be visualized as it courses from the ischial spine to the sacrum.
5. Once established, the window is gently enlarged in the axis of the vagina. This is usually accomplished by spreading the index and middle finger in the window to stretch the tissues. This window provides a clear view and easy palpation of ischial spine and coccygeus muscle. One retractor is placed in the 12 o'clock position to hold the cardinal ligament containing the ureter out of surgical field. Another retractor holds the patient's rectum to the left side. As the surgeon is working in a confined area (in the hollow of the sacrum) a fiber-optic headlight is useful. Bleeding from vessels is uncommon. If bleeding is present, it is

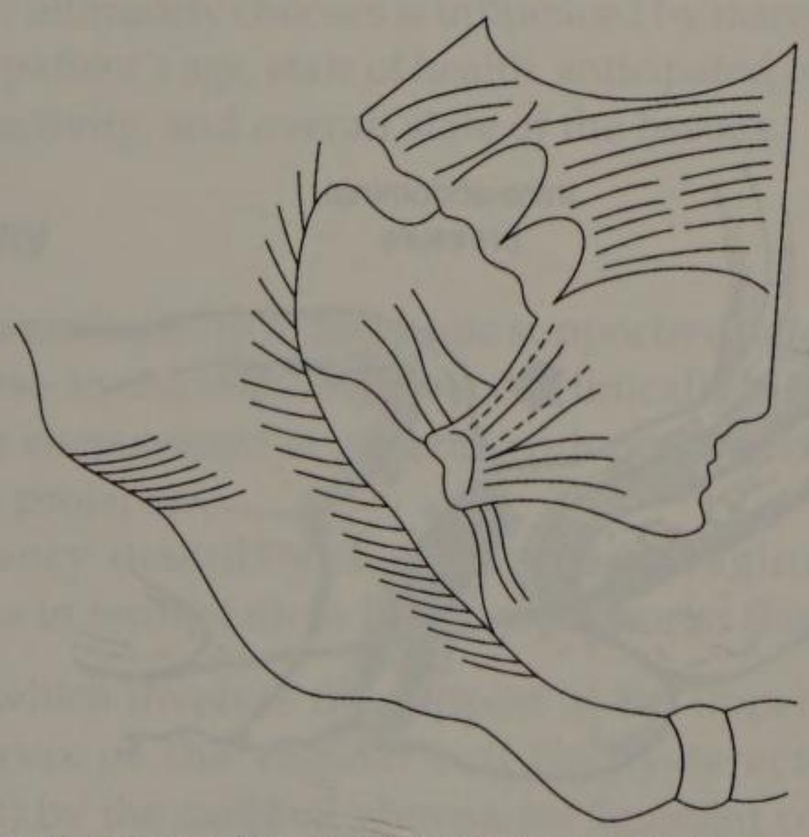


Fig. 28.3: Location of sacrospinous ligament deep within the substance of coccygeus muscle–shown by dashed line. Sciatic nerve and pudendal artery are located behind the ischial spine

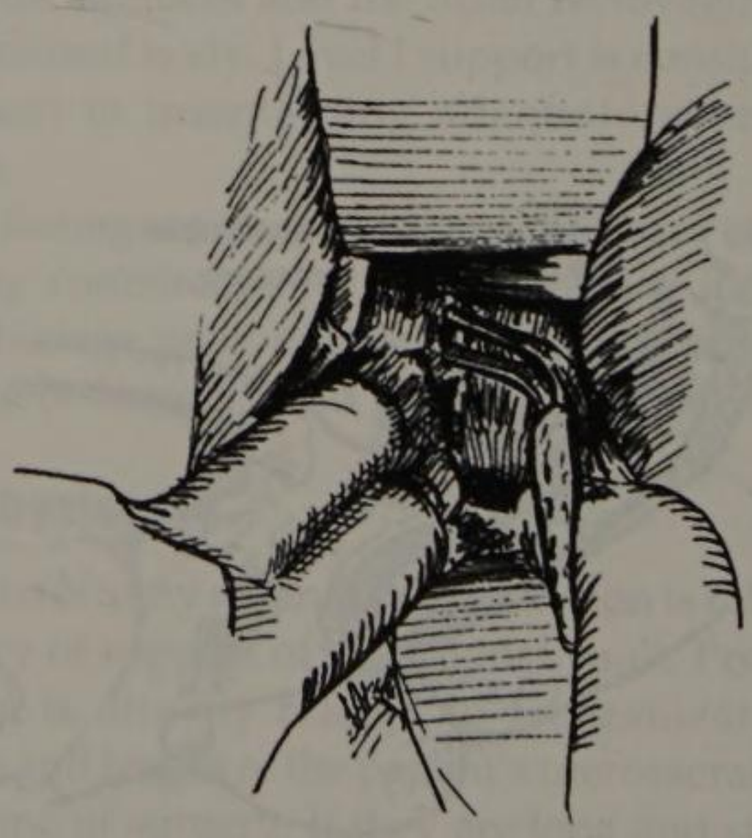


Fig. 28.4: The right rectal pillar has been penetrated by the tip of a long pointed forceps, providing entry to the right para-rectal space

usually venous and can be controlled by coagulation or by suture ligation.

6. At a point 2-3 cm medial to ischial spine, the SSL-coccygeus muscle complex is grasped by the tip of a long Allis or Babcock clamp and is penetrated by the blunt tip of a long handled Deschamps ligature carrier holding a full length of synthetic non absorbable. or delayed absorbable suture (Fig. 28.5).
7. The ligament can also be identified by palpation, as the examining finger feels ischial spine on either side and traces the finger like thickening of the ligament that runs posteriorly from this point to the hollow of the sacrum (Figs 28.6A and B).
8. After the suture, doubled has been passed through the ligament and caught by the hook, the ligature carrier is removed. The loop may be cut in the centre and each end paired with its respective free suture (Figs 28.7A to C).
9. Although, sacrospinous colpopexy may be performed bilateral, if the vault is wide enough to reach between the two ischial spines it is rarely done as equally satisfactory results are obtained with a unilateral colpopexy. But a wide vault should be surgically narrowed so that vagina is converted into a cylinder of uniform diameter (Figs 28.8A to C).
10. By a free needle, each suture is sewn to the undersurface of the midportion of the vaginal vault but the colpopexy stitches are not tied yet (Fig. 28.9).

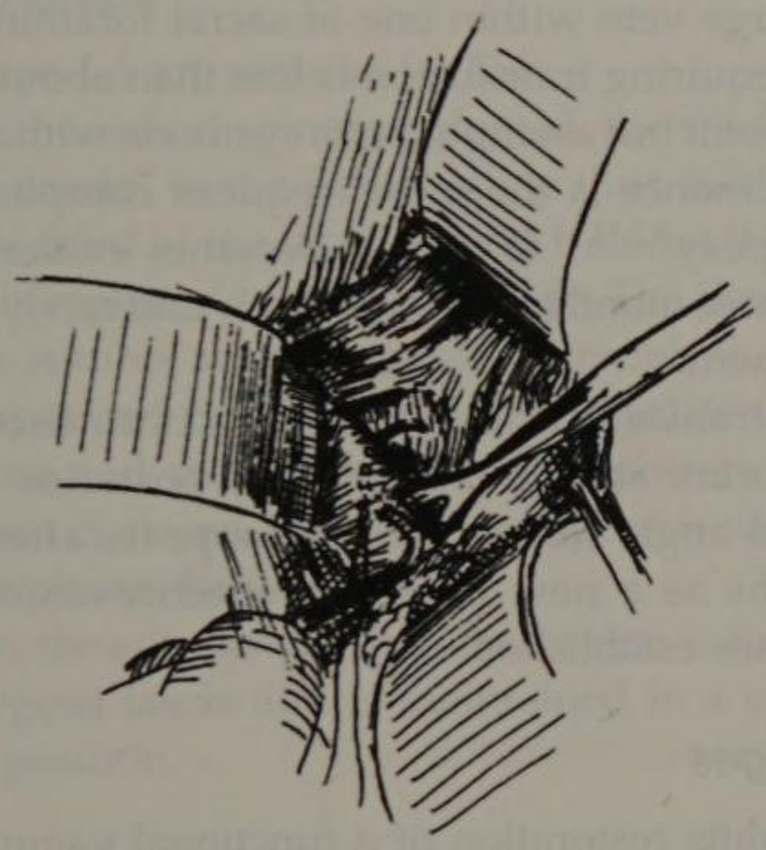
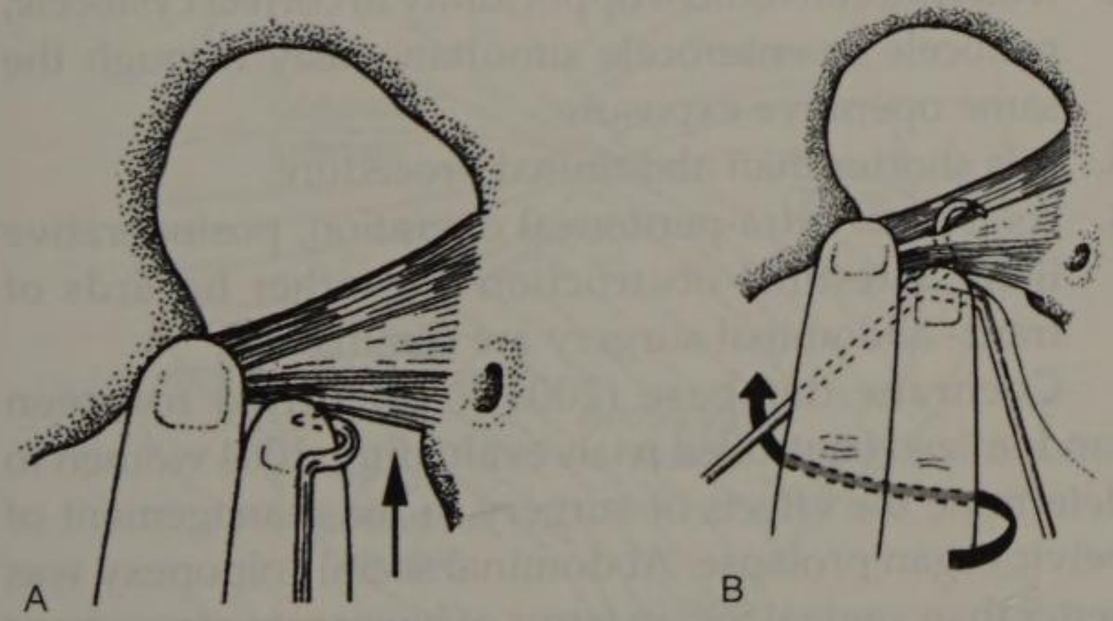
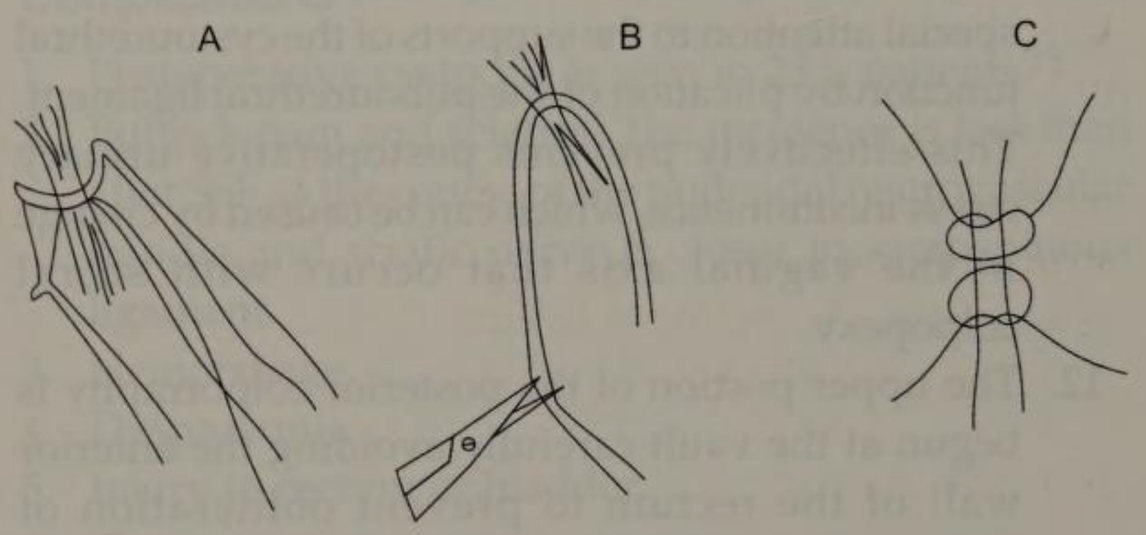


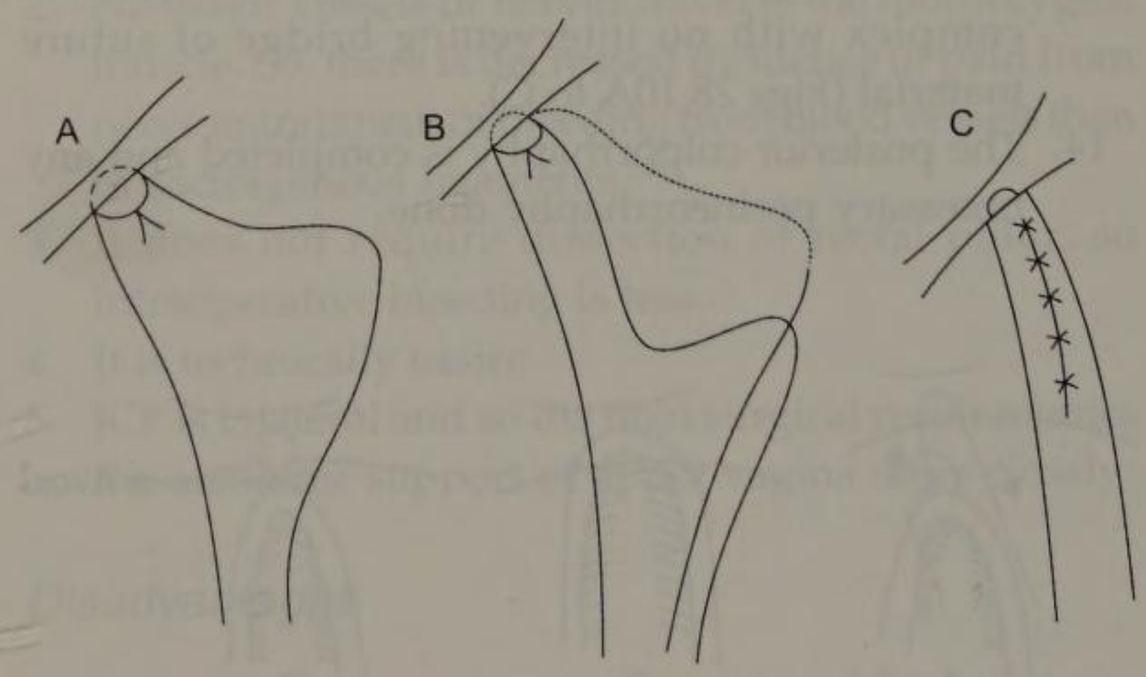
Fig. 28.5: Sacrospinous ligament has been grasped with Babcock clamp and penetrated by the suture-bearing tip of a long Deschamps ligature carrier



Figs 28.6A and B: (A) Index finger of left hand is inserted through window into perirectal space and tip of middle finger touches the right ischial spine, (B) The tip of the ligature carrier is rotated so as to penetrate this complex from below upwards



Figs 28.7A to C: Loop is cut in the centre and each end is paired with its respective free suture which results in suture through the ligament with one penetration by the ligature carrier



Figs 28.8A to C: (A) Wide vaginal vault at the left following sacrospinous colpopexy, (B) This can lead to prolapse of left side, (C) Vaginal shape has been converted to a cylinder with uniform diameter

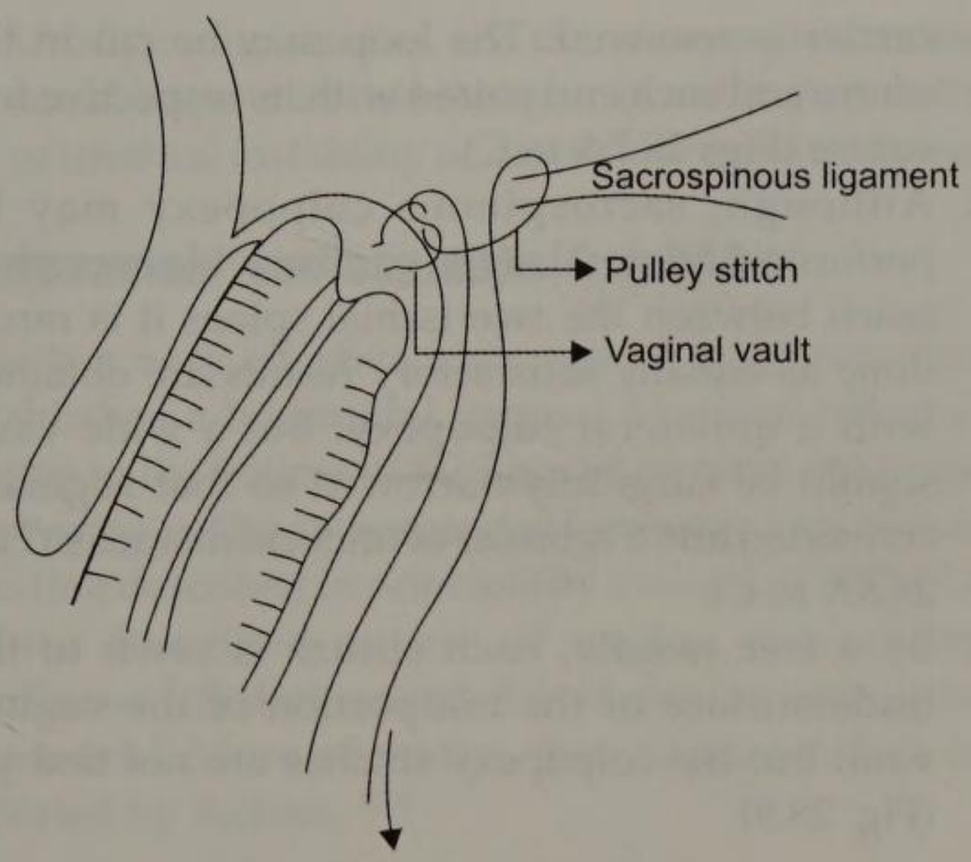
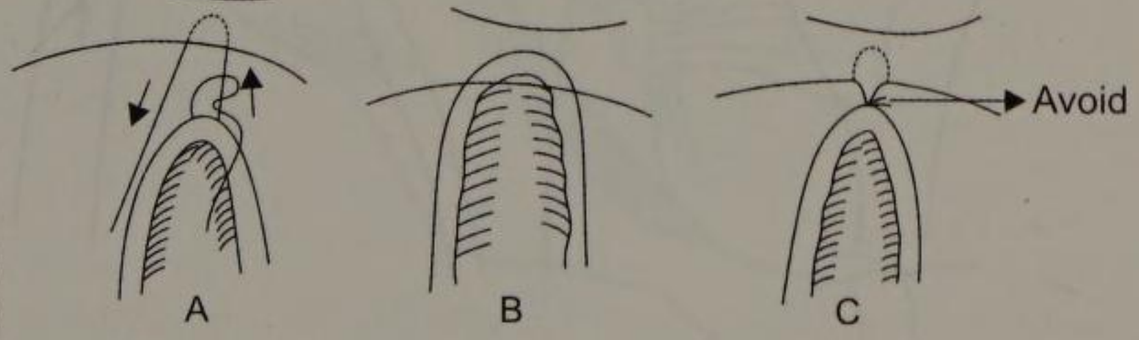


Fig. 28.9: The pulley stitch

11. Any necessary anterior colporraphy is done with special attention to the supports of the cystourethral junction by plication of the pubourethral ligament. This effectively prevents postoperative urinary stress incontinence, which can be caused by change in the vaginal axis that occurs with sacral colpopexy.
12. The upper portion of the posterior colporraphy is begun at the vault carefully avoiding the anterior wall of the rectum to prevent obliteration of rectovaginal space. These stitches continue to the mid portion of the posterior vaginal wall.
13. At this point, the sacrospinous colpopexy stitches are tied, firmly attaching the vagina to the surface of the coccygeus muscles—sacrospinous ligament complex with no intervening bridge of suture material (Figs 28.10A to C).
14. The posterior colporrhaphy is completed and any necessary perineorrhaphy done.



Figs 28.10A to C: (A and B) one end of pulley stitch fixed to the underside of the vagina, (C) Failure to tie this snugly results in a suture bridge, which should be avoided

Complications

1. Pudendal or sciatic nerve trauma is rare, occurring in about 1-2% of cases.[11] It is recognized by immediate severe postoperative gluteal pain running down the posterior surface of the affected ligament. It should be treated promptly by deligation and medial reposition of fixation sutures.
2. Injury to bladder or rectum can occur rarely. If at any time during the procedure rectal examination shows that a suture has transgressed the rectal wall, it should be promptly cut and replaced by a stitch in a proper position outside the rectal lumen.
3. Bleeding can occur deep within the pelvis and along the pelvic side wall and is usually of venous origin. Rarely, venous bleeding can be caused by trauma to the large vein within one of sacral foramina. Blood loss requiring transfusion is less than about 4.3%.[12]
4. Recurrent but asymptomatic cystocele without stress incontinence is the most frequent complication of colpopexy.[12,13,14] It usually becomes evident within first three months postoperatively and rarely requires treatment.
5. Mild transient urinary stress incontinence due to temporary straightening of the posterior urethrovesical angle can occur. It disappears after several months as a new posterior urethrovesical angle becomes established.

Advantages

1. It permits restoration of a functional vagina with a normal horizontally inclined upper vaginal axis thereby decreasing the chances of recurrence of vault prolapse.
2. It offers a convenient opportunity to correct cystocele, rectocele or enterocele simultaneously through the same operative exposure.
3. It is shorter than abdominal procedure.
4. As it is an extra-peritoneal operation, postoperative ileus, intestinal obstruction and other hazards of trans- abdominal surgery are diminished.

Cochrane database (2004)[15] identified fourteen randomized controlled trials evaluating, 1004 women to determine the effects of surgery in the management of pelvic organ prolapse. Abdominal sacral colpopexy was better than vaginal SSC in terms of lower rate of recurrent vault prolapse (RR 0.39, 95% CI 0.07 to 0.77) and less dyspareunia (RR 0.39, 95% CI 0.18-0.86). However, the vaginal sacrospinous colpopexy was quicker and cheaper

to perform and women had an earlier return to daily activities.

Bilateral Iliococcygeal Fixation

It was first described by Inmon in 1963.[16] Various authors have reported a success rate of over 90% with this technique after a follow up of 3 to 5 years.[17,18]

Anatomy

Ischial spine is the landmark for identifying the iliococcygeal or prespinous fascia which lies anterior to the spine. The sacrospinous ligament lies posteromedially to the ischial spine (Fig. 28.11).

Surgical Steps

Initial steps 1-5 are same as for SSF

6. Once the ischial spine is palpated, the stitch is taken 1 cm caudal to the ischial spine (just medial to the lateral third of the iliococcygeal muscle) (Fig. 28.12).
7. This is repeated on the other side. The iliococcygeal stitch sutures are then passed through the junction of upper and middle third of posterolateral vaginal mucosa and are not tied until the posterior vaginal mucosa is closed. Rest of the surgery is same as for sacrospinous fixation.

When the sutures are tied, the vagina is fixed to the iliococcygeus fascia and is maintained in a symmetric midline position.

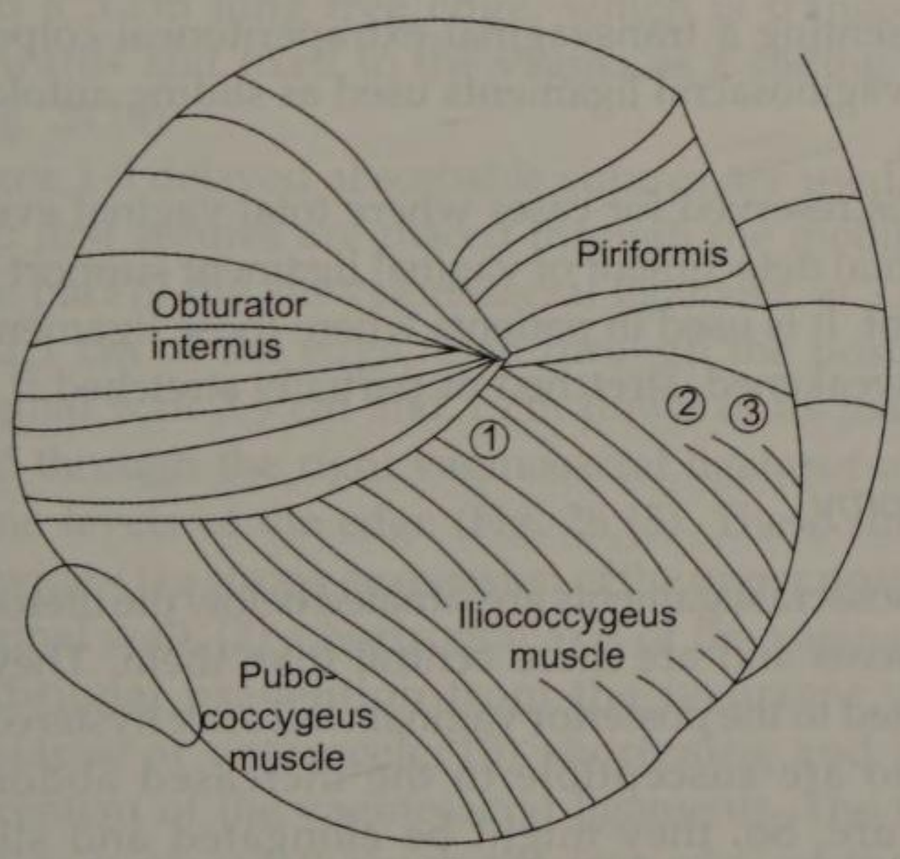


Fig. 28.11: Right medial view of the vaginal vault fixation sites. (1) Iliococcygeal fascia, (2) Coccygeal fascia, (3) Sacrospinous ligament

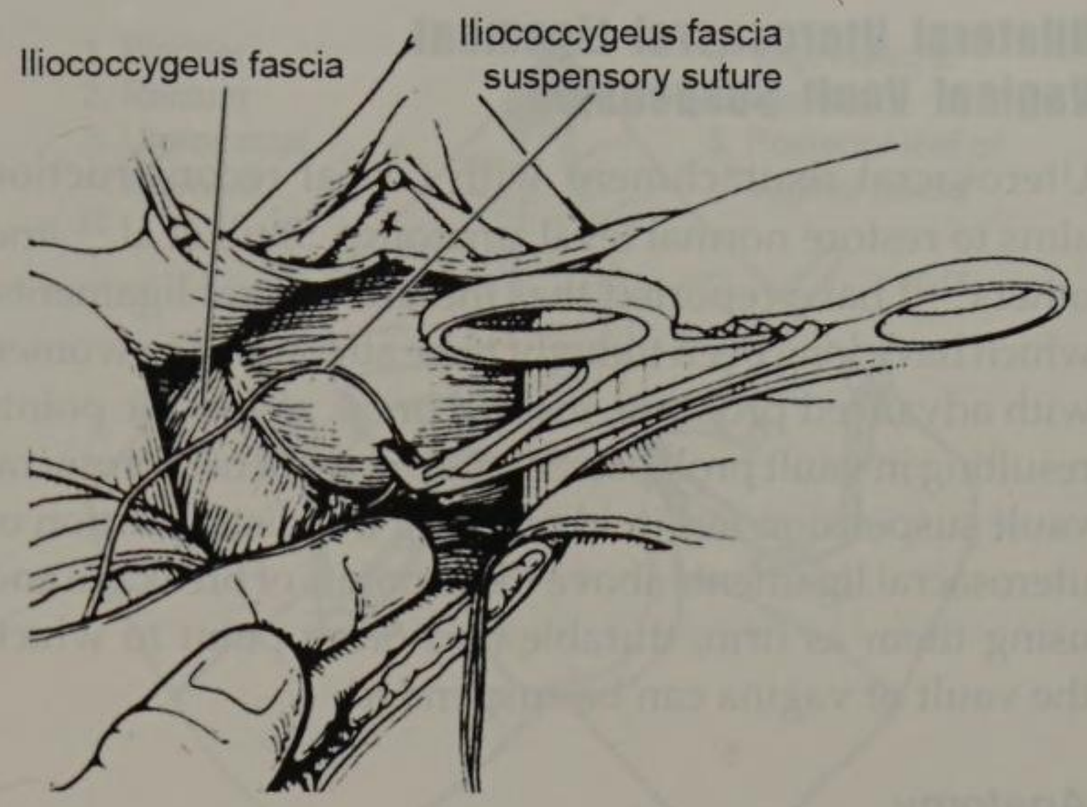


Fig. 28.12: Iliococcygeous fascial sutures have been placed

Complications

1. Postoperative cystocele is seen in 25% patients.[19]
2. Buttock pain and sciatica. The incidence is less than after SSF as the course of the pudendal neurovascular bundle and sciatic nerve is closer to sacrospinous ligament.
3. Hemorrhage.
4. Dyspareunia.
5. Injury to rectum or bladder.

Advantages

1. There is lower rate of postoperative cystocele. It is seen in 25% of patients as compared to 33% in SSF. [19]
2. No major vessels or nerves traverse the iliococcygeal muscle. So, there is decreased incidence of pain from nerve entrapment or bleeding from blood vessels than in sacrospinous ligaments.[20]
3. It does not require dissection of rectal pillar, so intraoperative bleeding is less.
4. It is technically easier.
5. ICF is bilateral and so the final surgical result mimics the anatomic support of upper vagina more closely.

Disadvantages

1. Extra-dissection is required and the additional tissue necrosis associated with bilateral iliococcygeus sutures compared with unilateral SSF leads to longer time required to return to daily activities.

Bilateral Uterosacral Ligament Vaginal Vault Suspension

Uterosacral reattachment with fascial reconstruction aims to restore normal level, anatomy. Shull et al [21] and others[22-24] have reported that the uterosacral ligaments, which have long been thought to be attenuated in women with advanced prolapse, instead break at specific points resulting in vault prolapse. So, the principle of uterosacral vault suspension lies in identifying the distal portion of uterosacral ligaments above these points of breakage and using them as firm, durable anchoring point to which the vault of vagina can be suspended.

Anatomy

The remnants of uterosacral ligament are found posterior and medial to the ischial spine. The ureters are palpated ventral and lateral to the spine. Cadaveric dissections have shown that the average distance form the ureter to the uterosacral ligament at the level of cervix was 0.9-1.4 cm.[25] As the uterosacral ligaments approach the sacrum, the distance to the ureter increased and the strength of the uterosacral ligaments decreased.

Surgical Steps

Initial steps 1-5 are same as for SSF.

6. The uterosacral ligaments are identified and gradually 'walked up' towards the sacrum using Allis clamps.
7. Identification may be aided by inserting a finger rectally and palpating the proximal rectovaginal fascia.
8. The proximal aspect of the ligament at the level of the ischial spine is used for re-suspension. Permanent sutures are passed through the ligament and are held.
9. The proximal ligaments are sutured to the recto-vaginal fascia laterally near the apex (Fig. 28.13).
10. Rest of the surgery is same as for SSF.

Complication

Ureteral injury 2.4%.

Advantages

1. Normal vaginal alignment.
2. Greater vaginal depth.
3. Recurrence of prolapse < 5%.

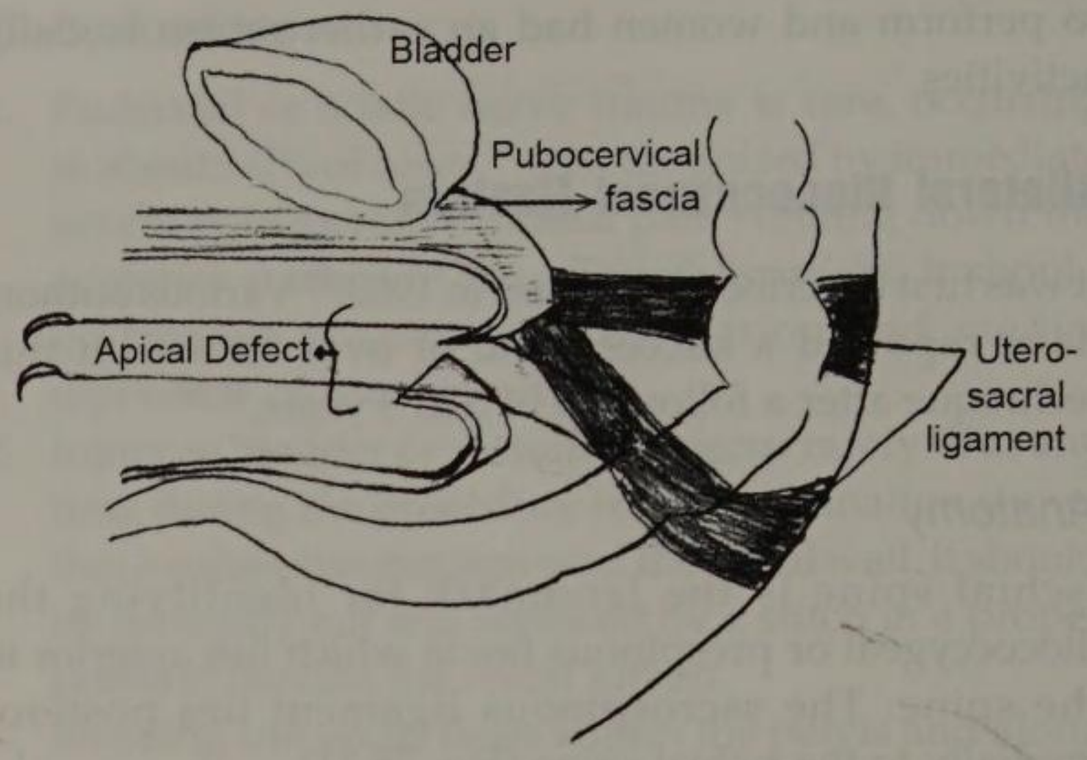


Fig. 28.13: Placement of permanent uterosacral suspension sutures through pubocervical fascia

Silva et al evaluated five-year anatomic and functional outcomes of uterosacral vault suspension [26]. They found 2.8% of patients had recurrence of apical prolapse. Postoperative urodynamic scores were significantly improved for irritative ($p = 0.01$), obstructive ($p = < 0.001$) and stress symptoms ($p = 0.03$) as were the female sexual function index scores. They concluded that lower urinary tract, bowel and sexual function is maintained or improved by this procedure. Similar results were confirmed by various other authors.[27]

Vaginosacral Colpopexy (VSC)

This is essentially a modification of McCall's operation representing a transvaginal extraperitoneal colpopexy with vaginosacral ligaments used as sliding autologous grafts.

It is reserved for cases where total vaginal eversion and total detachment of vaginal ligament support is not present. It is used in patients where those ligaments are only weakened, stretched or partially stretched.[28]

Anatomy

Vaginosacral ligaments are situated below the uterosacral ligaments and are more central than them. They stay attached to the posterior vaginal wall after hysterectomy and so are susceptible to the increased abdominal pressure. So, they might be elongated and slightly weakened in the uppermost part but still intact, strong and suitable as a natural suspensive material.

Surgical Steps

1. Vaginal apex is pulled down through the vaginal outlet by two long Kocher clamps placed on its both sides. A horizontal opening of vaginal vault, a sharp cleavage between the anterior vaginal wall and bladder in central zone, and an anterior midline longitudinal colporrhaphy to the external urethral meatus is made. A blunt finger dissection is done with a single gauze thickness along the strong vaginal fascia-Halban, stuck to the vaginal epithelium.
2. A dissection of the posterior and both lateral vaginal walls in their upper 1-2 cm from the rectum is performed. The inner free ends of the uterosacral ligaments become quite naked and well visible in the open vault. The lower structures vaginosacral ligaments, which are quite below the uterosacral ligaments and slightly more central and stay attached to the posterior vaginal wall after the hysterectomy. They are mobilized with a curved Kocher's clamp, replaced by stay ligature with 1-0 delayed absorbable suture. A wide blunt finger dissection of the rectum, situated between both vaginosacral ligaments, from the posterior vaginal endopelvic fascia is performed.
3. Two curved Kelly clamps are placed on the vaginal attachment of the vaginosacral ligaments and their farther mobilization with a sharp dissection between them and vaginal wall is made. Two stay ligatures with 1-0 delayed absorbable sutures are placed on their mobilized ends. This procedure provides a satisfactory mobilization of the vaginosacral ligament and a 3 cm long free edge, which is transposed upwards and fixed to the vagina as a sliding graft (Fig. 28.14).
4. Three 1-0 delayed absorbable sutures are used. The two first sutures are placed through the mobilised, free part of the left vaginosacral ligament, at 2.5 cm and 1 cm of the edge, then through the posterior vaginal wall 2.5 cm and 1 cm down of its margin, and through the right vaginosacral ligament at the same levels of the edge (Fig. 28.15). These sutures provide: (1) a strong suspension of the upper posterior vaginal wall; (2) a horizontal axis of the vagina and additional prevention from the recurrent vault prolapse or enterocele; (3) shortening and reinforcement of the vaginosacral ligaments. The third suture is placed through the free edge of the left uterosacral ligament, circularly through the central third of the posterior vaginal margin, and finally through the free edge of the right uterosacral ligament. This suture provides an additional elevation and elongation of the vagina and reinforcement of the suspension. At the end these three sutures are tied separately in the central area.
5. At the end a circular 1-0 delayed absorbable suture is taken through the whole vaginal free edge and a tight vaginal tamponade is made.

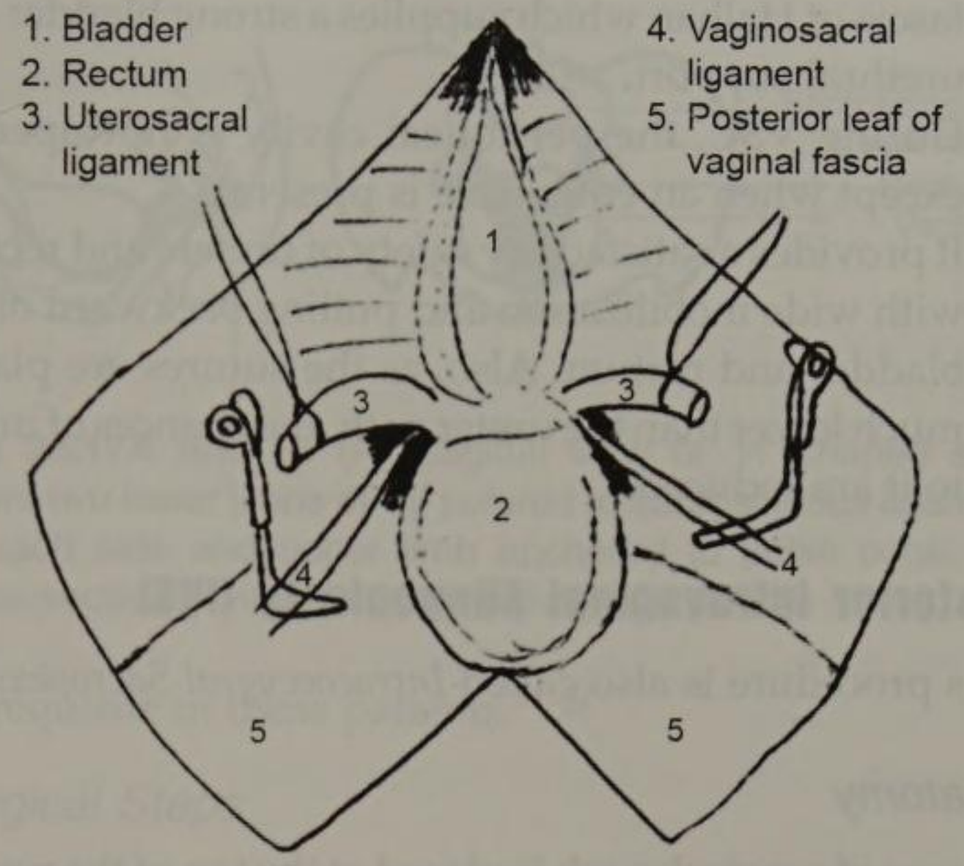


Fig. 28.14: Mobilisation of vaginosacral ligaments

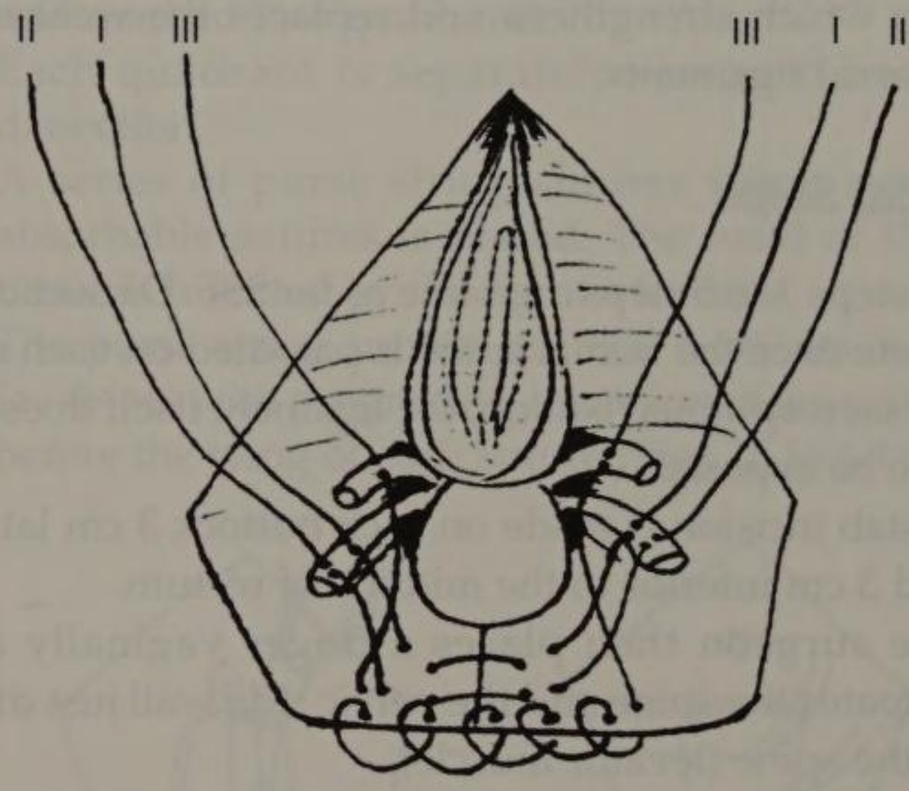


Fig. 28.15: Correct suture placement of sutures I to III

Complications

1. Ureter, bladder or bowel injury.
2. Bleeding.

Advantages

1. During VSC, the dissection of the vaginal epithelium remains stuck to its underlying strong endopelvic

fascia of Halban which supplies a strong bladder and urethral support.
2. During VSC, the peritoneal cavity is not opened, except when an enterocele is present.
3. It provides a satisfactory safety of ureters and rectum with wide mobilization and pulling backward of the bladder and rectum. Also, as the sutures are placed much lower than the ureter path, the chances of injury to it are reduced.

Posterior Intravaginal Slingoplasty (IVS)

This procedure is also called *Intracoccygeal Sacropexy.*

Anatomy

A piece of surgical mesh is placed at the top of the vagina in a tension free manner through the pelvic sidewalls to support vaginal vault. A fibrous reaction occurs around the top which strengthens and replaces the weakened uterosacral ligaments.

Surgical Steps

Initial steps 1 to 5 steps are same as for SSF. Dissection is complete once the ischial spine is palpated on each side unlike sacrospinous fixation, the ligament itself does not need to be exposed.

6. A stab incision is made on each buttock 3 cm lateral and 3 cm inferior to the midline of rectum.
7. The surgeon then places a finger vaginally and palpates the spine and the pelvic side wall just distal to the spine (levator muscle).
8. The trocar is advanced through the stab incision in to the ischiorectal fossa (pararectal space) and towards the dissecting finger at the vaginal apex. The tape is attached to the tip of the stylet and pulled out through the trocar and the tape left at the apex of vagina.
9. The procedure is then completed on the other side. The mesh is attached to the apex of the vagina and vaginal incision is closed (Fig. 28.16) The excess mesh is cut off at the buttock incision and these are closed with steristrips. There is evidence that tissue ingrowth into mesh occurs within 24 hours.

Complications

1. Bleeding.
2. Rejection or erosion of mesh.

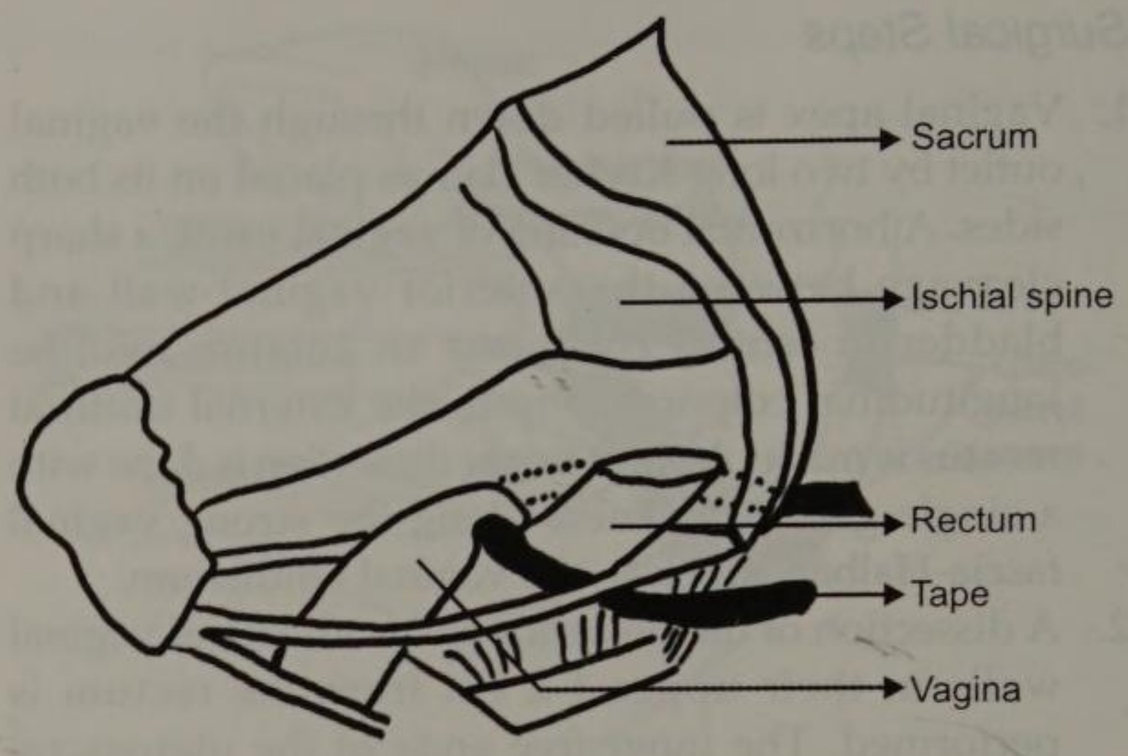


Fig. 28.16: Side view of mesh around rectum and attachment to vagina holding the vault in place

3. Bowel or rectal injury.
4. Vaginal scar tissue formation and/or pain.
5. Infection.

Success rates in the literature have been reported at approximately 90%.

Advantages

1. Minimally invasive.
2. Decreased bleeding.
3. Decreased risk of nerve injury.
4. Can be done under local/regional anaesthesia.
5. Decreased recovery period.

Transvaginal Mesh Repair

The technique of graft placement for the correction of anterior, posterior and apical vaginal wall reconstitution is not difficult to perform but controversy exists regarding the optimal choice of material use of both synthetic and donor graft has been advocated. As of now, type I or macroporous synthetic mesh is widely used and it has the advantage of being readily available, cost effective and consistent in quality. But it has significant complications, including infection and erosion. In contrast, allografts/xenografts provide naturally occurring biomaterials that may undergo desired remodeling, but the invivo response is not fully understood.[29]

Surgical Steps

1. Initial steps 1-5 are the same as Sacrospinous Fixation

2. Once the ischial spines are palpated , Polypropylene sutures are placed 1 cm medial to the sacrospinous ligament. Two sutures are placed on either side.
3. A premeasured rectangular piece of mesh about 3 cm wide and 8 cm in transverse length is chosen and the polypropylene sutures previously placed through the sacrospinous ligaments are brought through the lateral ends of this piece of mesh.
4. Three more additional 2-0 polyglactin sutures are placed through the width of the mesh.
5. The ends of these sutures are placed through the anterior and posterior flap 1 cm away from the vaginal mucosal incision. The mesh is then tied down to the sacrospinous ligament.
6. The polypropylene sutures are brought out posterolaterally through the intact vaginal mucosa and the incision in vaginal mucosa is closed.
7. The polyglactin sutures previously placed through the flap are tied over the closed vaginal mucosa, thus securing the vaginal vault to the mesh.
8. The polypropylene sutures are then tied, thereby bringing the lateral ends of the vaginal vault to sacrospinous ligament.
9. The polypropylene sutures are cut short. Though initially palpable, they gradually get covered by the vaginal mucosa.
10. For vault prolapse associated with cystocele, a horizontal H shaped one piece sling is used to support both components (Figs 28.17A and B).

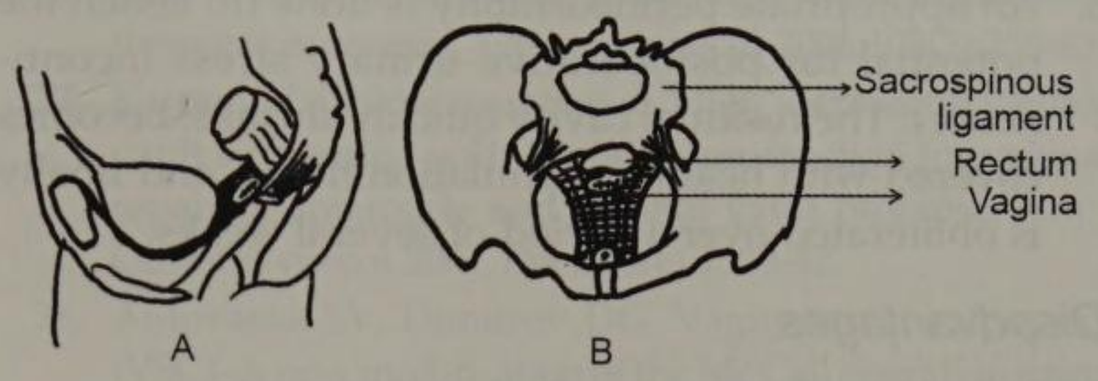
Complications

1. Gluteal/perineal pain.
2. Postoperative urgency, which usually resolves within 3 months.
3. Constipation secondary to pressure over the rectum due to the bridging mesh is seen in 13% of patients.
4. Dyspareunia.
5. Mesh erosions.
6. Prolapse recurrence in 4-6% of patients.

Shah et al[30] in a retrospective analysis of 29 consecutive patients who underwent transvaginal SSF using mesh reported this as an effective method till 2 years of follow-up. Cochrane database 2004 revealed that for anterior vaginal wall prolapse, standard anterior repair was associated with more recurrent cystocele than when supplemented by Vicryl mesh overlay (RR1.39,95%CI 1.02 to 1.90). But data on morbidity and other clinical outcomes are too few for reliable comparisons.

Colpectomy

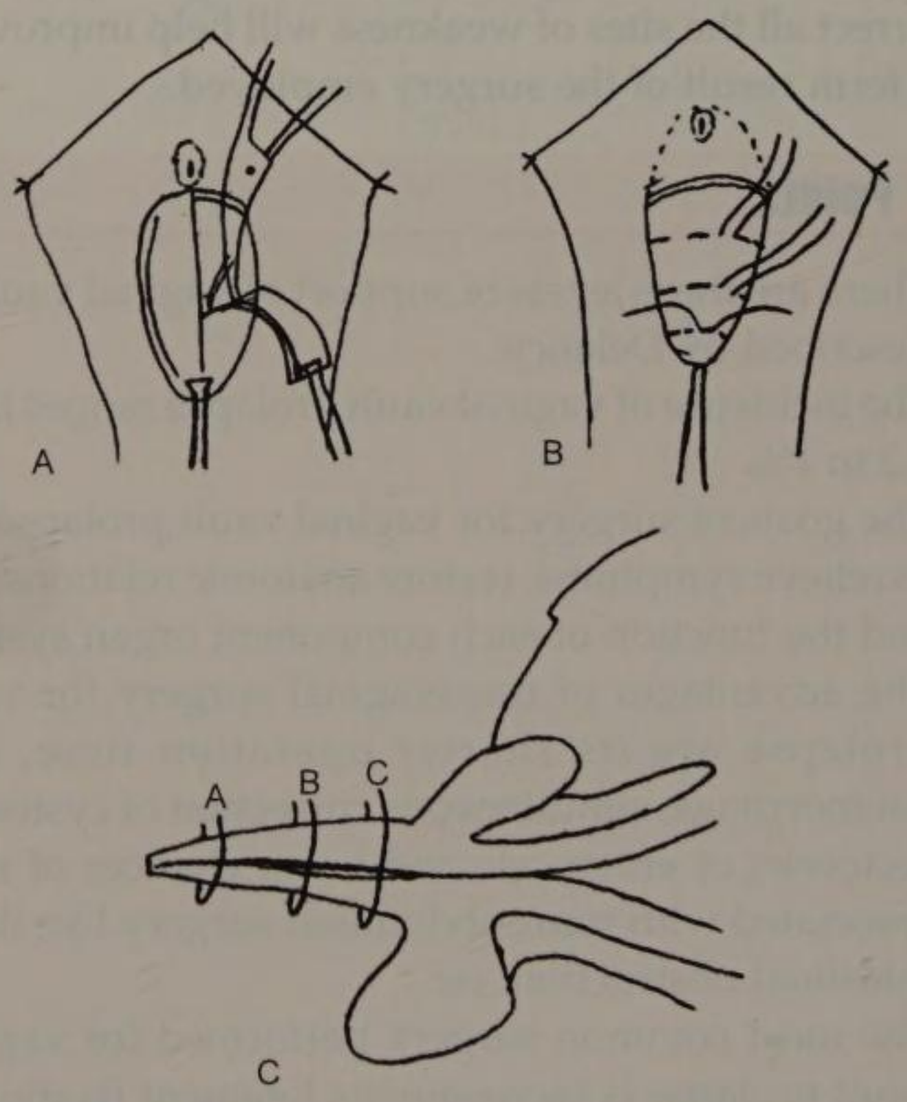
It is done in patients who are old, and are high risk for surgery. Conservation of vaginal function is no longer a prerequisite in these patients.[31, 32]



Figs 28.17A and B: (A) Sagittal view of 'H' shaped sling shows two lower limbs of 'H' sutured to sacrospinous ligament on each side and upper limb anchored to pubic bone, (B) Cross-sectional view through pelvic inlet

Surgical Steps

1. Subcutaneous infiltration is given by 0.5% lidocaine in 1:200,000 epinephrine solution.
2. Vagina is circumscribed by an incision at the hymen and marked into quadrants.
3. Each quadrant is separately removed by sharp dissection.
4. A series of purse string sutures using synthetic absorbable sutures is placed. The vault of the soft tissue is inverted by the tip of a forceps.
5. The purse string sutures are tied from down above (a→b→c) with progressive inversion of the soft tissue before the tying of each suture (Figs 28.18A to C).



Figs 28.18A to C: (A) Vagina is circumscribed by an incision at the hymen and marked into quadrants, (B) Series of purse string synthetic absorbable sutures are placed, (C) Purse string sutures are tied from above down

6. An appropriate perineorraphy is done (to lessen the potential for postoperative urinary stress incontinence). The residual cavity quickly shrinks, becomes covered with healthy granulation tissue, and finally is obliterated over a period of several weeks.

Disadvantages

1. It limits or destroys vaginal coital function.
2. As the operation is extra-peritoneal, it will not remove any enterocele.
3. Chances of postoperative urinary stress incontinence are increased due to flattening of the posterior urethrovesical angle.
4. Increased blood loss during surgery.

CONCLUSION

Our understanding and concepts of pelvic organ prolapse and its treatment is constantly evolving. For successful repair of posthysterectomy vault prolapse, the various causes, tissue strengths and damages should be identified and correlated with a choice of different surgical procedure. The ultimate goal is to restore the natural depth and position of the vagina, while at the same time effectively treating any coexistent pelvic disease, including cystocele, enterocele and rectocele. So, accurate perception, correct diagnosis and an adequate procedure to correct all the sites of weakness will help improve the long term result of the surgery employed.

Key Points

1. There are three levels of support of vaginal vault as described by Delancy.
2. The incidence of vaginal vault prolapse ranges from 0.2 to 1%.
3. The goals of surgery for vaginal vault prolapse are to relieve symptoms, restore anatomic relationships and the function of each component organ system.
4. The advantages of transvaginal surgery for vault prolapse are its shorter operation time, less haemorrhage, simultaneous correction of cystocele, rectocele, or enterocele and lesser chances of risks associated with trans-abdominal surgery like ileus, intestinal obstruction, etc.
5. The most common surgery performed for vaginal vault prolapse is sacrospinous ligament fixation.
6. Recent advances in the trans-vaginal vault correction are the iliococcygeal fixation and mesh repair.

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29

Complete Perineal Tear

Harsha Khullar, SK Bhandari, Kanika Jain, Geeta Mehdiratta

INTRODUCTION

Anal incontinence affects women eight times more often than men. The reason for this difference is considered to be childbirth. A tear involving the anal sphincter during vaginal delivery has a great bearing on a woman's future continence. Upto one in four primiparous women suffer from altered faecal continence following labour and about one in three have demonstrable evidence of anal sphincter injury after vaginal delivery. Upto 50% of women with third or fourth degree perineal tears during childbirth suffer from faecal incontinence. The incidence reported for third degree tears in primigravidae is 2.8% as compared to 0.4% in multigravidae.

Definition and Classification of Perineal Tear

In order to understand the patho-physiology of perineal trauma, an understanding of the anatomy of pelvic floor is required (Figs 29.1 and 29.2).

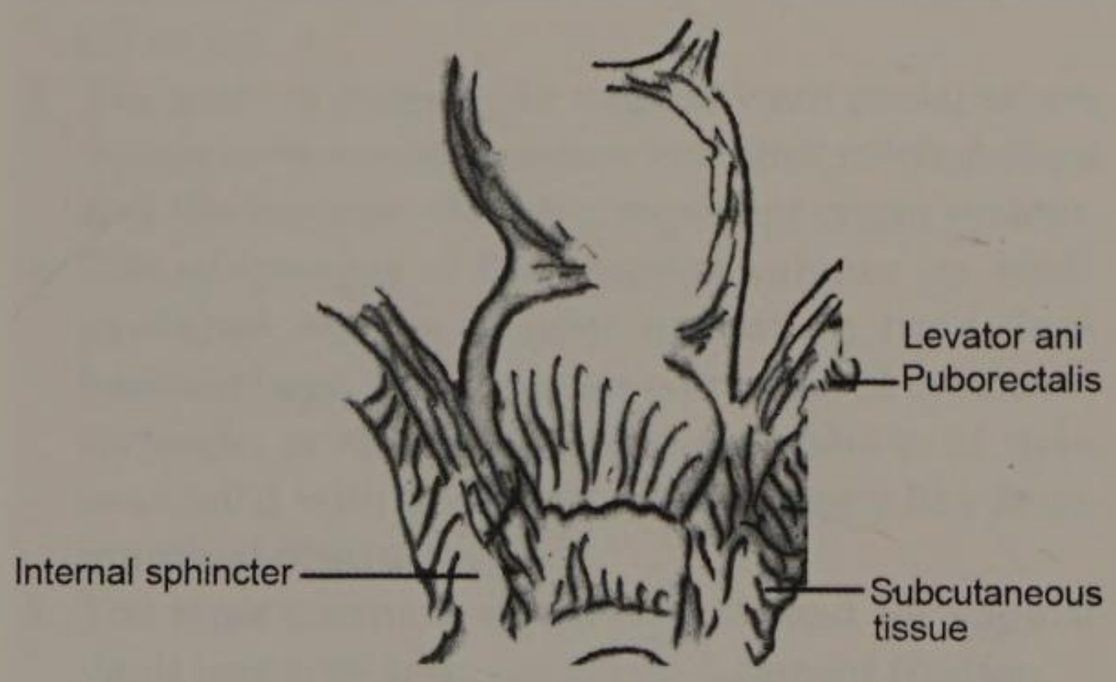


Fig. 29.1: Anatomy of the anal canal and sphincter

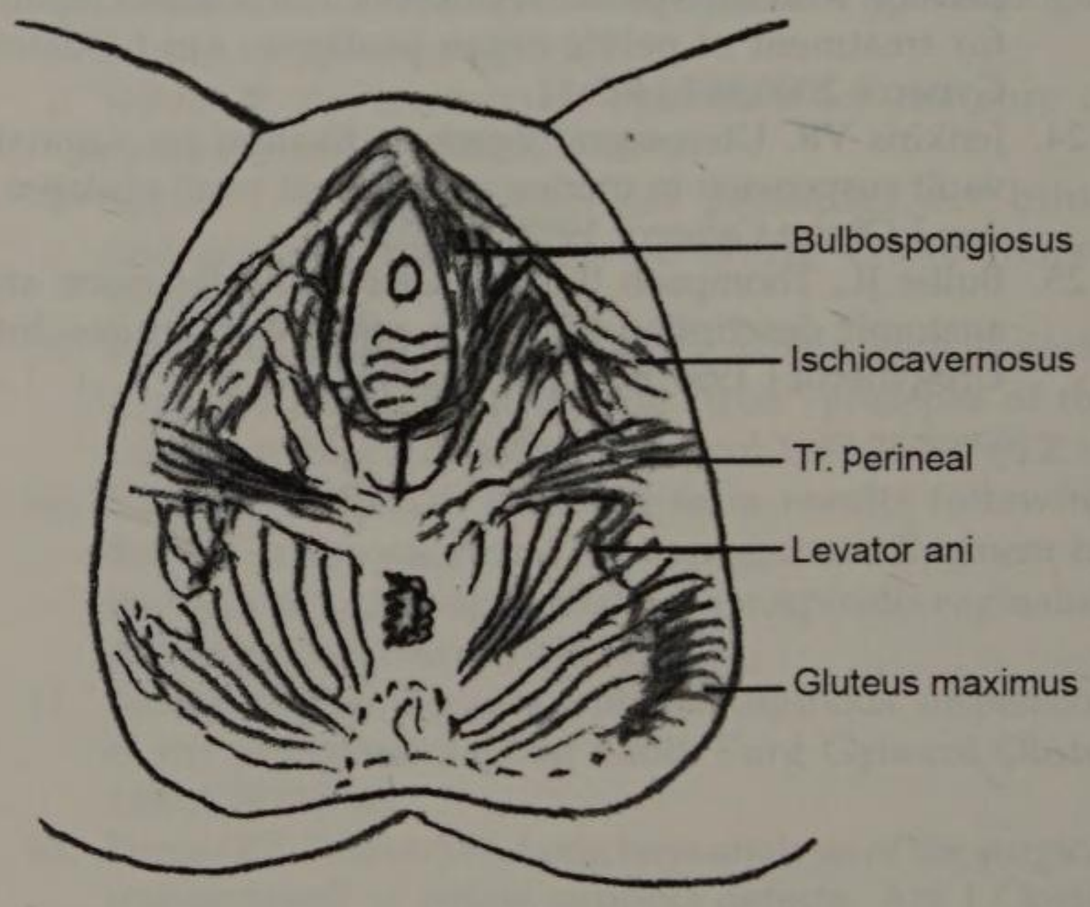


Fig. 29.2: Muscles of pelvic floor

Abdul H. Sultan scrutinized 65 textbooks on obstetrics relevant to obstetric tear and found that the following classification was adopted in 32 textbooks. Out of which 15 were of American origin, four were British and one Australian.

William's obstetrics classifies perineal tear as:

First degree: Laceration of the vaginal epithelium and perineal skin only.

Second degree: In addition to first degree, involvement of the perineal muscle and fascia but not the anal sphincter muscles.

Third degree: Disruption of the skin, mucous membrane, perineal body and external anal sphincter muscles.

Fourth degree: A third degree tear with disruption of anal epithelium.

RCOG classifies anal sphincter damage as follows:

3a: less than 50% of external anal sphincter is torn.

3b: more than 50% of the external anal sphincter is torn.

3c: Tear involving the internal anal sphincter (almost always involves the complete disruption of external sphincter.)

Fourth degree: Injury to the anal sphincter complex extending into the rectal mucosa.

The College acknowledges that the identification of trauma to external anal sphincter is difficult in acute settings, and therefore the simple definition of third degree and fourth degree trauma is likely to be more applicable in practice.

An isolated rectal tear without involvement of anal sphincter is rare and should not be included in the above classification.

A tear involving the anal sphincter during vaginal delivery has great bearing on a woman's future continence. Third degree perineal rupture occurs in 0.4 –5% of deliveries. It is an infrequent complication of vaginal delivery but women affected may experience serious emotional, psychological and sexual problems.

Mechanism of Continence

It is imperative to know the mechanism of continence because realignment of the tissues is very important. This is facilitated if sutures are placed correctly in the first attempt of corrective surgery to approximate the junction of vaginal epithelium and perineal skin.

Continence is the ability to control the evacuation of rectal contents voluntarily.[1]

This control is dependent on:

1. Adequate reservoir capacity.
2. Intact local neurological system.

The predominant factor involved in anorectal continence is the presence of an intact innervated anal sphincter muscularis. This component is most commonly damaged during labour.

External sphincter (ES) is responsible for the ability to control solid faeces. Ten to fifteen percent of the resting sphincter tone is by the pressure generated from contraction of external sphincter muscle. ES contracts in response to raised intra-abdominal pressure so as to prevent leakage of contents during coughing, sneezing etc. Internal sphincter (IS) is responsible for the anal sphincter tone at rest and it plays a role in the rectoanal inhibitory reflex, which is an inhibition of anal tone provoked by rectal distension and allowing rectal contents into the upper anal canal. This enables the person to sense whether the contents are liquid or solid. Rectal filling results in reflex contraction of the rectal muscle wall and temporary relaxation of internal sphincter. Contraction of ES during waking hours postpones defecation to a convenient time.

Puborectalis muscle plays an important role in maintaining the continence. The angle between the lower section of rectum and posteriorly directed anal canal is formed by the puborectalis pull (Figs 29.3 and 29.4).

Various theories have been put forward to explain the mechanism of continence. According to Flap valve theory due to increase in the intra-abdominal pressure, the anterior rectal wall is pushed down on the upper anal canal and there is urge to defecate. Another theory is that the urge to defecate results from the stimulation of stretch receptors not in the rectal wall but in the muscles of the levator plate, external sphincter and puborectalis muscle.

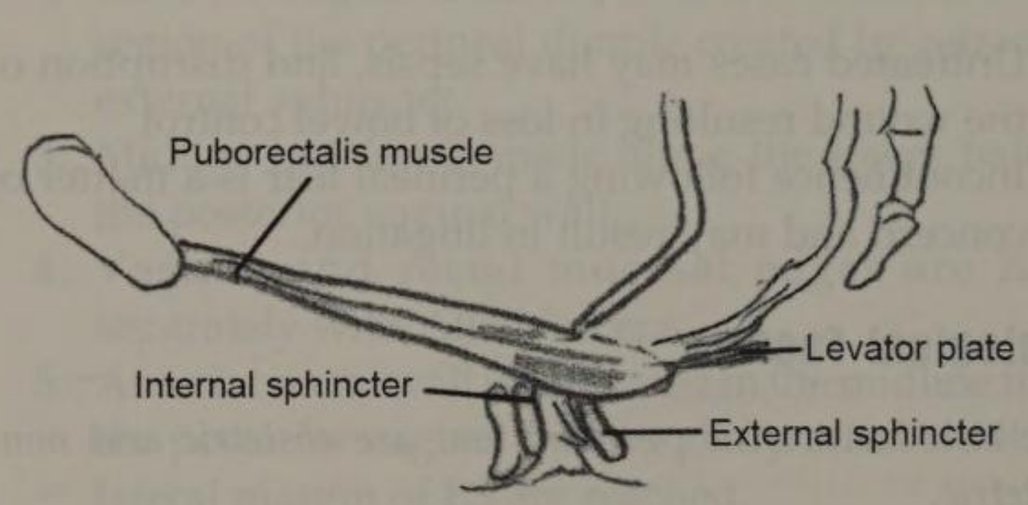


Fig. 29.3: Anal canal at rest

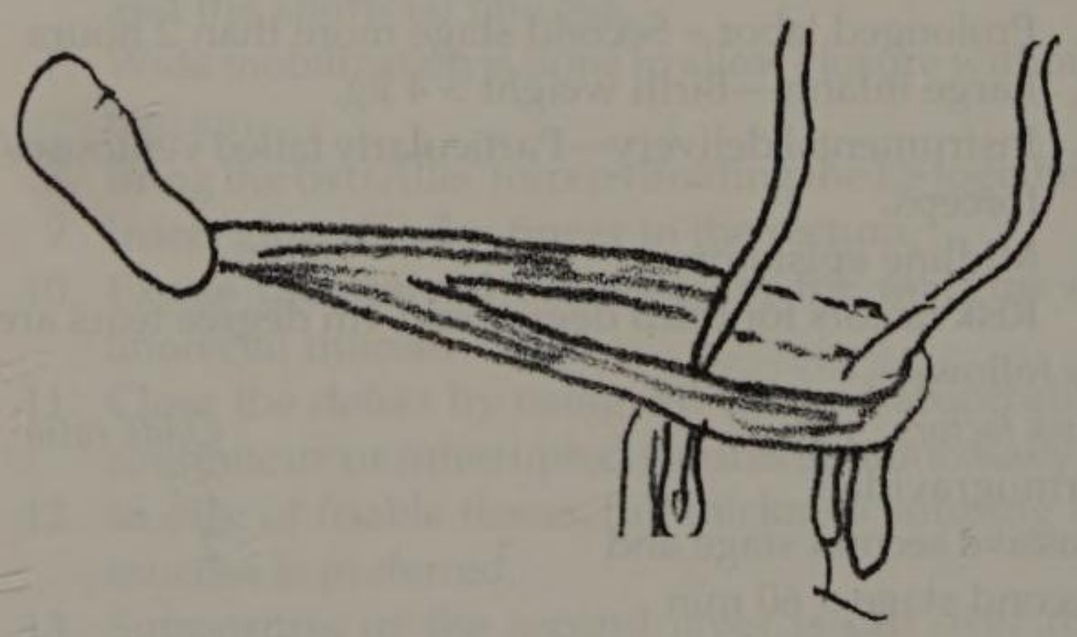


Fig. 29.4: Anal canal at defecation

The internal sphincter (IS) and external sphicter(ES) maintain continence below the level of the puborectalis muscle. At rest the anal canal is kept closed by the baseline tone of the IS and the constant tonic activity of the ES.

There is reflex relaxation of IS caused by the stool in rectum by the involuntary rectoanal inhibitory reflex. This sampling reflex allows the bolus (solid, liquid or gas) to enter the proximal anal canal. Upper part of the anal canal is sensory rich. As the distension occurs, there is contraction or relaxation of pelvic floor muscle depending on the social condition. As the rectal filling continues IS contracts once again to facilitate rectal closure. If there is social inconvenience the ES along with the puborectalis muscle strongly contracts so as to force back the contents into the rectal reservoir. ES and puborectalis can be contracted for one minute only. If the IS is injured, there is loss of anal canal tone and this does not allow the contraction and the contents pass out.

Why is it Important to repair a Complete Perineal Tear?

1. Untreated cases may have sepsis, and disruption of the wound resulting in loss of bowel control
2. Incontinence following a perineal tear is a matter of concern and may result in litigation.

Etiological Factors

The risk factors for perineal tear are *obstetric* and *non-obstetric*.

Non-obstetric factors include trauma to the perineal region due to any fall or accident.

Obstetric factors include the following:

1. Prolonged labor – Second stage more than 2 hours.
2. Large infants—Birth weight > 4 kg.
3. Instrumental delivery—Particularly failed ventouse/ forceps.
4. Midline episiotomy.

Risk factors for third degree and 4th degree tears are as follows:

Risk factors	*Odds ratio*
Primigravidae	2:7
Passive second stage and second stage > 60 min	2
Instrumental delivery	1.7:7
Midline episiotomy	5:11
Macrosomia	2.9
Previous third degree tear	4

Review of literature shows that 36 of 50 (72%) women who developed a third degree tear had a posterolateral episiotomy. In 25 women it was forceps delivery. Seventeen out of 50 women had one risk factor, 24 had two risk factors and 6 had three risk factors i.e., 94% of women had more than one risk factor. Out of 25 non-instrumental deliveries in 11 (44%) episiotomies were performed whereas 14 (56%) had spontaneous delivery without episiotomy.

A Cochrane review including six studies reveals that restrictive episiotomy was involved in less postnatal perineal trauma. Henriksen et al found in an observational study involving 2188 pregnant women that the group with lowest rate of episiotomies were more likely to have an intact perineum but no increased risk of having a tear of anal sphincter. Later publication showed that there was a tendency towards an increased rate of tears if one tries to reduce the episiotomy rates below 20%.

Clinical Presentation and Recognition

The involvement of the internal and external sphincter results in different clinical presentations. *Internal sphincter incompetence results in fecal incontinence while external spinchter incontinence cause fecal urgency*. All women should be examined to assess the degree of perineal, vaginal or rectal injury after vaginal delivery. The ES should be palpated between two fingers i.e., one in the vagina and other in the rectum. All women who have an instrumental delivery or who have had extensive perineal injuries should be examined by a registrar or consultant trained in recognition and management of perineal tears.

Repair of 3rd and 4th Degree Perineal Tear

Identification of Extent of Tear

The patient is examined carefully to assess the severity of damage to the perineum, vagina and rectum. It is very important to examine carefully for rectal extension as a small buttonhole tear can be missed and these may lead to fistula formation later on. When there is disruption of the anal sphincter, it retracts to form a dimple on either side of the anal canal. If the rupture of the rectal mucosa has occurred, it involves damage to both IS and ES. It is very important to know the extent as a good repair is strongly associated with future fecal incontinence.

In case of third and fourth degree tear, the tear extends well above the ES and IS and the high-pressure

zone of the anal canal is completely lost leading to leakage of gas and faeces at all times. Complete breakdown of the perineal body, separation of the entire sphincter and extension of tear through rectal muscles results in incontinence of solid stool.

Timing of Repair

The repair is performed as soon as conveniently possible after the diagnosis.

If repair at the time of delivery breaks down, second attempt should be deferred for a minimum of 8 weeks to provide sufficient time for resolution of inflammatory response, return of adequate blood supply to the margins and return of the viability of the perineal tissues. All sphincter ruptures should be repaired in the operation theatres as it provides sterile environment and better lighting facilities. A good repair of the sphincter is imperative as this is the factor most strongly associated with future continence. A consultant or senior registrar with experience in the third and fourth degree tear repair should undertake this procedure.

Preoperative Preparation

1. Proctoscopic examination should precede the second attempt so that presence of an occult RVF can be excluded.
2. Bowel preparation: Soft diet 2 days prior to repair, liquid diet and colo-rectal wash 1 day prior to repair.
3. I/V antibiotics: A single dose of broad-spectrum prophylactic antibiotics should be administered at the time of repair, e.g. 1 gm first generation cepholosporins with 500 mg metronidazole IV.

Anaesthesia

Adequate relaxation is very important because other than eye muscle, the anal sphincter and pelvic floor muscles are the only striated muscles in the human body that are in a state of tonic contraction at rest. Regional or general anesthesia is imperative, Local anesthesia can be used in cases where superficial fibers of external sphincter are torn.

Suture Material

Any of the following suture materials may be used for repair of a perineal tear, keeping in mind that a fine delayed absorbable suture with adequate tensile strength is required.

1. The 3-0 delayed absorbable material (vicryl) is used for repairing defects of anal mucosa.
2. The 2-0 polyglycolic acid is used for repair of rectal mucosa.
3. The 2-0 or 3-0 PDS (Poly dioxanone) is ideal because it has long tensile retention.
4. Non-absorbable suture should not be used as they can be the focus of infection.

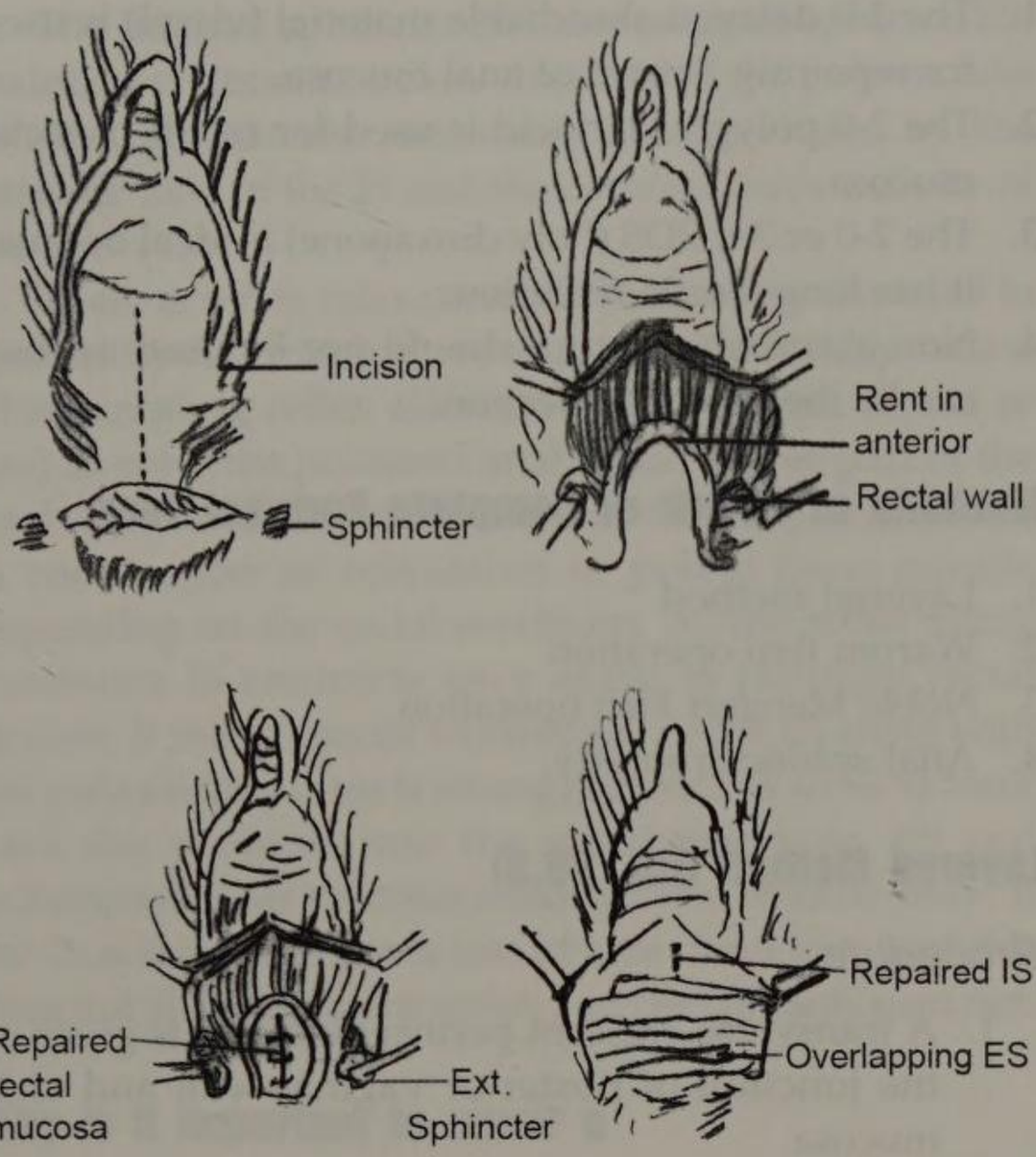
Methods of Repair of Complete Perineal Tear

1. Layered method
2. Warren flap operation
3. Noble Mengert Fish operation
4. Anal sphincteroplasty.

Layered Method (Fig. 29.5)

Procedure

1. A transverse crescent perineal incision is given at the junction of posterior vaginal wall and anal mucosa.
2. Lateral margins of the incision are extended to the region of the perineal dimple created by retracted external sphincter.
3. Midline incision is made along the lower half of the posterior vaginal wall.
4. Vaginal and rectal mucosal edges are held separately with Allis' forceps.
5. Anterior rectal wall is separated in the midline from the posterior vaginal wall by sharp scissors till the lateral margin of ES are reached.
6. White fibrous tissue, the thickened distal condensation of the circular smooth muscle layer of the rectum (IS) can now be seen between the ES and the anorectal mucosa.
7. Wide mobilization is done to allow closure without tension.
8. Bring the two Allis' forceps holding the ES together.
9. Insert gloved index finger in the rectum.
10. Excise the scarred tissues from the margins of anorectal mucosa.
11. Close the defect by using 3-0 delayed absorbable continuous or interrupted sutures submucosally.
12. In case of friable tissue, full thickness suturing of mucosa is preferred.
13. Supporting or the second layer is put over the stitched line. This layer is responsible for most of the resting pressure as it takes off the tension by isolating the mucosal layer.



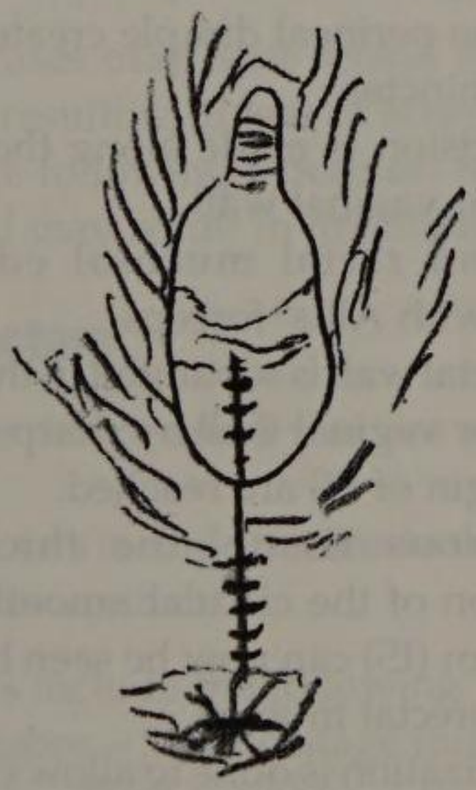


Fig. 29.5: Layered method of repair

Advantages of Continuous Sutures over the Interrupted Suture

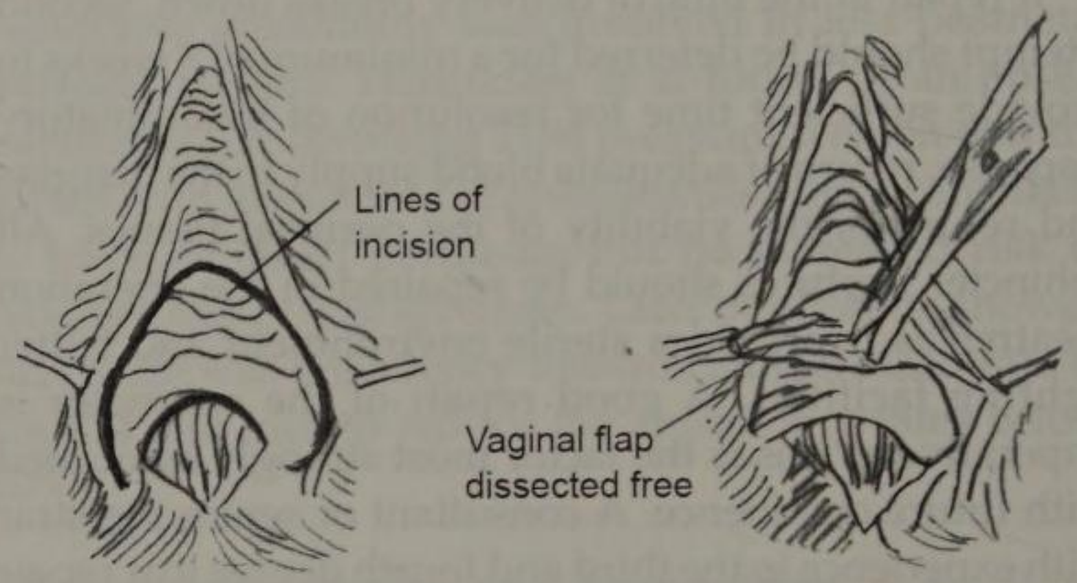
1. Tension is distributed along the entire suture line.
2. It prevents gap in the closure that could occur from ischemia if the interrupted suture is tied too tight.
3. It is associated with less pain at 10 days than a standard interrupted repair.
4. Less suture material is used.

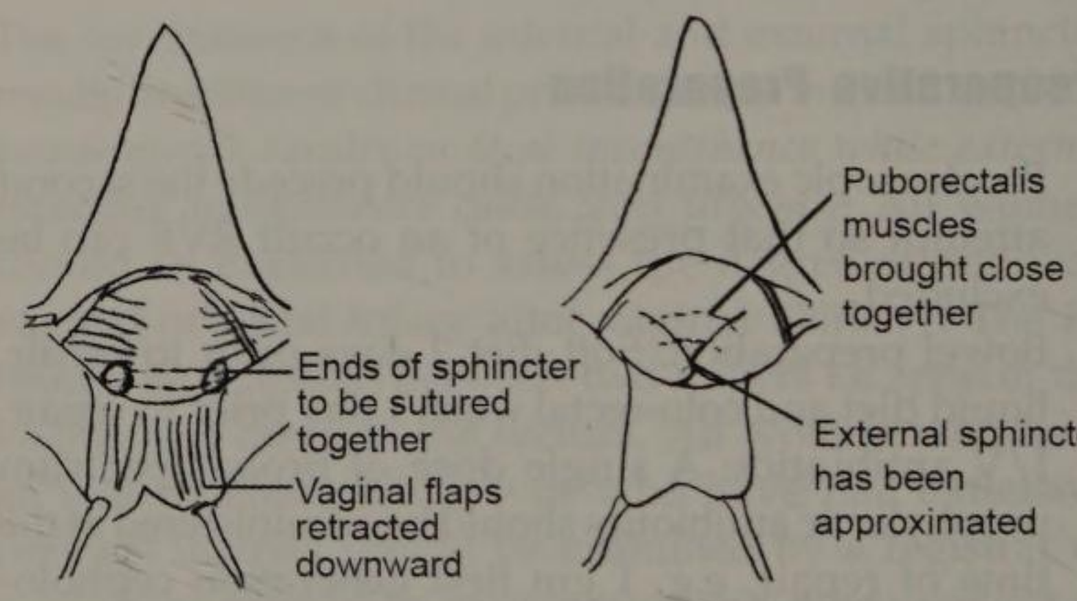
WARREN FLAP REPAIR (FIG. 29.6)

It was first described in 1882.

Procedure

1. An inverted V-shaped incision is given in the posterior vaginal mucosa. Lower end of incision should be just lateral to the dimples caused by retracted sphincter ends.




Ends of sphincter to be sutured together
Vaginal flaps retracted downward
Puborectalis muscles brought close together
External sphincter has been approximated

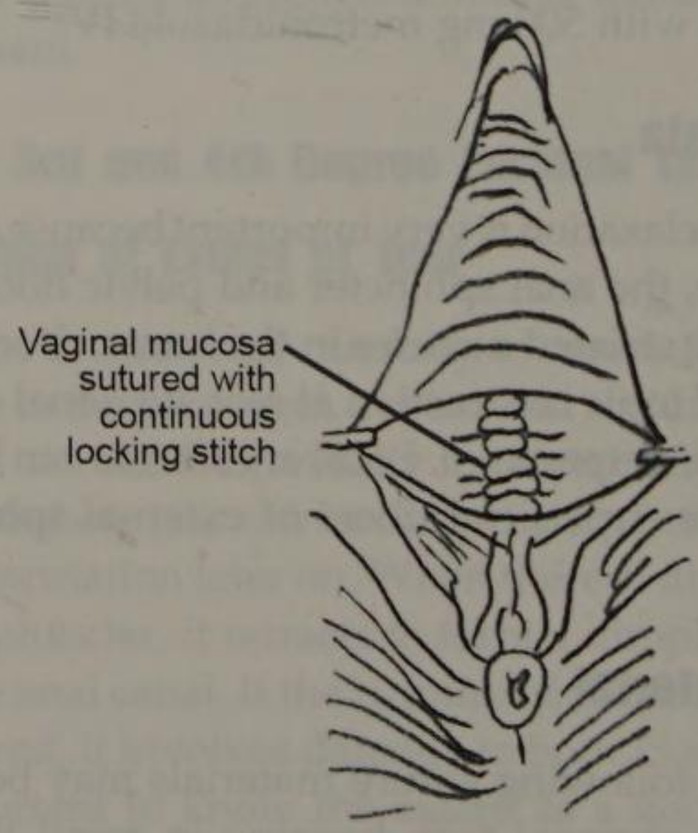


Fig. 29.6: Warren flap repair

2. Length of the flap should be minimum 3 cm so that sufficient vaginal mucosa can be incorporated into the anal canal.
3. Dissection should be proper so that the areas overlying the sphincter end is denuded.
4. The two ends of flap are held with Allis forceps and turned down so as to hang over the anus.
5. The external anal sphincter ends are held.
6. Using 0 or 2-0 delayed absorbable sutures; the fascia overlying the medial aspect of puborectalis muscle is brought together with a series of interrupted sutures.
7. The vaginal mucosa is sutured with 3-0 delayed absorbable sutures.

Advantages of Warren Flap Repair Method

1. It avoids mucosal incision in the anus
2. It provides a pedicle graft of vaginal mucosa for enlargement of perineal skin.
3. It provides more cosmetic results to perineal body.

Noble Mengert Fish Operation (Fig. 29.7)

Procedure

1. The torn perineal, anal and rectal tissue forms a butterfly appearance across the perineum in the case of complete perineal tear.
2. The lateral perineal dimples of the retracted end of external anal sphincter form the wings of the butterfly.
3. Initial incision is made along the margins of this anatomic defect.
4. Dissection is carried out and the perineal skin is left attached to facilitate later dissection of the retracted ends of the external sphincter.
5. Place atraumatic clamps along the margins of the anal canal and using sharp dissection separate the anal wall from the overlying vaginal mucosa.
6. Mobilize the vaginal mucosa from the anal canal and lower rectal wall laterally to the underlying levator muscles and proximally upto the middle or upper third.
7. Once the ES ends are mobilized to meet in the midline with traction in the Allis clamps, excise the overlying skin.
8. Approximate sphincter end in the midline by including several of sutures with muscular layer of anterior rectal wall.
9. Plicate puborectalis muscle.

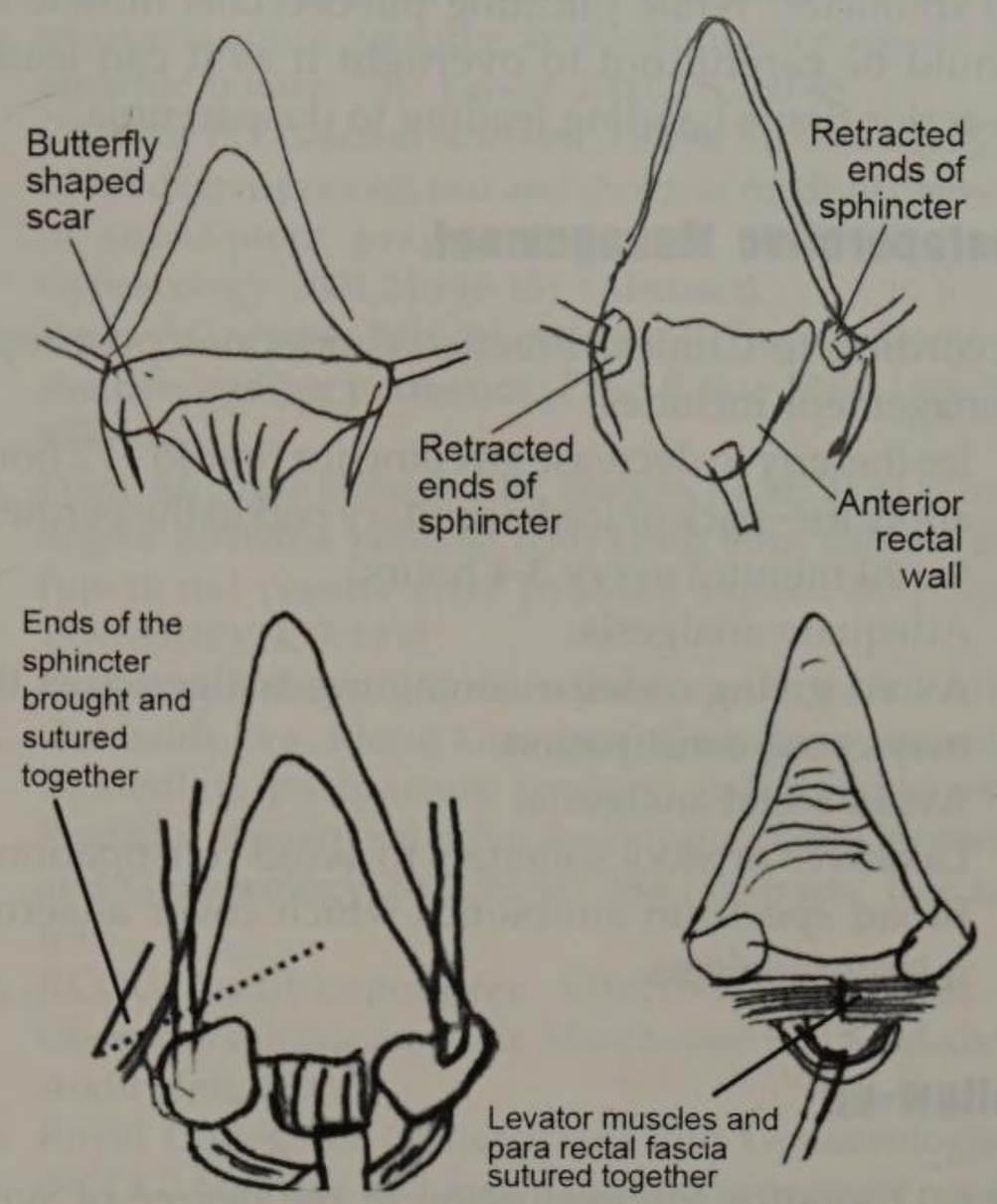

Butterfly shaped scar
Retracted ends of sphincter
Retracted ends of sphincter
Anterior rectal wall
Ends of the sphincter brought and sutured together
Levator muscles and para rectal fascia sutured together

Fig. 29.7: Noble operation

10. Reapproximate the transverse perineal muscle and inferior margin of bulbocavernosus muscle.
11. Trim the vaginal mucosa and approximate posterior vaginal wall with 3-0 delayed absorbable suture.
12. Perianal skin is approximated in the middle.
13. Draw outside the mobilized anterior wall of the anal canal and suture it to the perianal skin without tension.
14. Trim the excess anal mucosa taking care to remove as little of the distal anal canal as possible because this tissue contains IS.

Overlapping Sphincteroplasty

The principle behind this procedure is to use scarred ends of the torn sphincter and to hold the sutures that constitute the circumferential sphincter.

The support to anal canal is provided by plicating the puborectalis muscle by extending suture in the fascia to the mid position of vagina and bringing together the disrupted ends of the superficial transverse muscle and the bulbocavernosus muscles.

Avoid dissecting beyond 8 and 9 o'clock position because that is the position where pudendal nerve enters

the sphincter. While plicating puborectalis muscle one should be careful not to overtight it as it can lead to posterior tissue banding leading to dyspareunia.

Postoperative Management

According to Clinical Practice Guidelines post-repair management includes:

1. Ice therapy to decrease swelling for first 48 – 72 hours: apply ice - pack or iced a sanitary pad to the perineum for 20 minutes every 3-4 hours.
2. Adequate analgesia.
3. Avoid giving codeine containing analgesics as they may cause constipation.
4. Avoid rectal analgesia.
5. Laxatives or stool softeners to avoid constipation.
6. Broad spectrum antibiotics which cover anaerobic microorganisms.

Follow-up

At 6-12 months full evaluation of the degree of symptoms of incontinence is done.

In cases where sphincter disruption is demonstrated and fecal incontinence is debilitating following primary repair, a repeat surgery may be required earlier.

1. Ensure that the patient has had a chance to discuss subsequent delivery with a senior member of the team.
2. Prescribe necessary analgesic and stool softeners.
3. Advise on perineal hygiene.
4. Physiotherapy.
5. Counsel regarding sutures : Occasionally migrate and fragments may be passed per vaginum.

Subsequent delivery following perineal tear repair can be grouped into:

1. Previous third/fourth degree tear with no ongoing symptoms.
2. Patients with symptoms.
3. History of secondary anal sphincter repair.
4. Asymptomatic but with demonstrable anal sphincter defects or abnormal manometry on testing.

Group I: These patients should be counseled that there is approximately 4% risk of further anal sphincter damage in a subsequent vaginal delivery .In patients who were transiently incontinent after their first delivery, 17%- 24% may develop worsening symptoms after subsequent delivery.

Group II: There is risk of worsening of symptoms, which may make their life more difficult. Every effort should be made to avoid operative vaginal delivery and lengthy second stage.

Group III and Group IV: Women should be delivered by caesarean section.

Reducing Risk of Perineal Tears

1. Episiotomy: Midline episiotomy increases the risk of extended trauma. When episiotomy is restricted, an increase in anterior vaginal trauma is seen.
2. Perineal massage in multipara during the weeks before giving birth protects against perineal trauma.
3. Ventouse delivery is associated with less perineal trauma as compared to forceps delivery.
4. Epidural analgesia has been seen to be associated with an increased risk of instrumental vaginal delivery and second stage of labour is also prolonged with continuous epidural analgesia. It is advisable to allow the descent of head with passive second stage.

During primary repair if sepsis is suspected it is advised to abandon the procedure and delay the reconstructive surgery for 3-6 months. In cases with multiple failed attempts to sphincter repair, functioning colostomy followed by repair and closure of colostomy later is the alternative. Similarly, in cases where rectal incontinence with sepsis is present, two stage operation is recommended.

CONCLUSIONS

Anal incontinence is a debilitating disease. Mechanism of continence must be understood well. Primary repair is best. Difficult IInd stage of labour should be avoided.

Key Points

1. Anal incontinence is 8 times more common in females than in males
2. Third degree tear is reported in 2.8% of primigravidae and 0.4% of multigravidas.
3. 50% of women with 3rd and 4th degree perineal tear suffer from fecal incontinence
4. Obstetrics risk factors namely prolonged labour, large neonates (> 4 kg)/instrumental delivery, midline episiotomy have all been implicated as common etiological factors.
5. Restricting episiotomy results in less perineal trauma.

6. Repair of 3rd and 4th degree perineal tear should be performed by senior consultant/senior registrar with experience.
7. Primary repair if done well has the best outcome
8. Optimum results are obtained when repair is performed in OT with adequate anaesthesia and lighting. Use of correct suture material is crucial for best results.
9. Layered method of repair has been associated with best long-term results.
10. Proper documentation of delivery events and operative details is very important for future and medico-legal aspects.
11. In subsequent delivery following perineal tear repair there is 4% risk of anal sphincter damage.

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30

Radical Vaginal Hysterectomy

Partha Basu

INTRODUCTION

Radical hysterectomy for cancer of cervix was introduced in Vienna during the end of the nineteenth century by Schauta and Wertheim. Schauta advocated the surgery by vaginal route whereas Wertheim did the same abdominally in conjunction with pelvic lymphadenectomy to increase the radicality of the procedure. The morbidity and mortality rates of Schauta's technique were less than Wertheim's technique though the cure rates for both the techniques were the same. Master surgeons like Victor Bonney and Meigs patronized the Wertheim's operation and made the surgical procedures more refined to achieve higher cure rates and less morbidity and mortality. Professor Subodh Mitra from Calcutta combined extra-peritoneal pelvic lymphadenectomy with Schauta's radical vaginal hysterectomy and described the new procedure (Mitra Operation) in his monograph in 1960.[1] The advantages of Mitra operation were; better resection of extensive vaginal disease, less postoperative morbidity (as the abdominal cavity is kept open for shorter time and the approach is retroperitoneal); better suited for obese and medically compromised patients. However, most contemporary surgeons found the Mitra's technique of radical vaginal hysterectomy complicated and cumbersome as it required three incisions.[2] Cases with extensive vaginal extension of cervical cancer were subjected to radiation therapy that was found to give better result than any form of radical hysterectomy. Mitra's operation lost the edge over Wertheim's operation. As a result Mitra's operation went into oblivion and Wertheim's operation became the standard of care for early stage non-bulky carcinomas of cervix.

The evolution of laparoscopic approach to lymphadenectomy has renewed the interest in radical vaginal hysterectomy. The pelvic lymph nodes can be removed and various parts of the hysterectomy can be performed laparoscopically before completing the radical hysterectomy by vaginal route. This would allow rapid postoperative recovery and less hospital stay.[3] Roy and colleagues retrospectively compared the patients undergoing laparoscopic pelvic lymphadenectomy followed by vaginal radical hysterectomy (N=25) with patients having laparoscopic lymphadenectomy followed by abdominal radical hysterectomy (N=27). Estimated blood loss (EBL), operative time, incidence of blood transfusion, and postoperative stay were comparable between the two surgical approaches. At the end of a mean follow-up period of 27 months the authors concluded that both procedures were equally safe and efficacious.[4]

Radical trachelectomy, the fertility preserving radical surgery for cervical cancer has a few surgical steps common with radical vaginal hysterectomy. Naturally a surgeon conversant with radical vaginal hysterectomy will have the necessary skill to do radical trachelectomy.[5]

The current chapter will discuss the steps of Mitra operation though in reality it has become an operation mainly of historical interest practiced by a very select group of surgeons. Re-emergence of radical vaginal hysterectomy may occur in the near future along with laparoscopic lymph node dissection.

Indications for Surgery

Indications are the same as those of Werthiem's radical hysterectomy i.e., Stage I, IIA invasive cervical cancer

up to 4 cm maximum diameter of the tumor. Tumours greater than 4 cm in diameter are better treated by radiotherapy with or without concomitant chemotherapy.

Surgical Technique

The steps of the Mitra operation will be discussed in two parts: technique of extra-peritoneal pelvic lymphadenectomy and technique of radical vaginal hysterectomy. The lymphadenectomy is done first through abdominal route along with the ligation of ovarian and uterine vessels and partial dissection of the parametria. The rest of the surgery is completed vaginally putting the patient in lithotomy position.

Extra-Peritoneal Lymphadenectomy

In Mitra operation the lateral pelvic side walls are approached extra-peritoneally using two separate inguinal incisions, one for each side. The inguinal incision extends downwards and medially from a point at the junction of lateral third and medial two-third of a line joining the anterosuperior iliac spine and the umbilicus. The incision ends at the pubic tubercle (Fig. 30.1)

Skin and subcutaneous tissues are excised to expose the external oblique aponeurosis that is split along the line of the fibres (i.e., parallel to the line of the incision) up to the superficial inguinal ring. As the superficial ring is cut, the inguinal canal is opened and the conjoint tendon formed by the internal oblique and transversus abdominis muscles is exposed (Fig. 30.2). A tunnel is formed by introducing a finger below the conjoint tendon to separate the internal oblique, trasversus abdominis muscles and fascia trasversalis from the underlying peritoneum. The muscles and the fascia are incised along the line of the incision. (Fig. 30.3) The inferior epigastric vessels are dissected out and cut between ligatures. (Fig. 30.4)

Fig. 30.2: Finger introduced through superficial inguinal ring to dissect the internal obliqe, transversus abdominis muscles and fascia transversalis from underlying peritoneum

The peritoneum is gently retracted from the pelvic sidewall starting from the retropubic space of Retzius and going cephalad. The round ligament is encountered as a band entering the inguinal canal after piercing the

Fig. 30.1: Mitra incision extending to pubic tubercle. Index finger on anterosuperior iliac spine

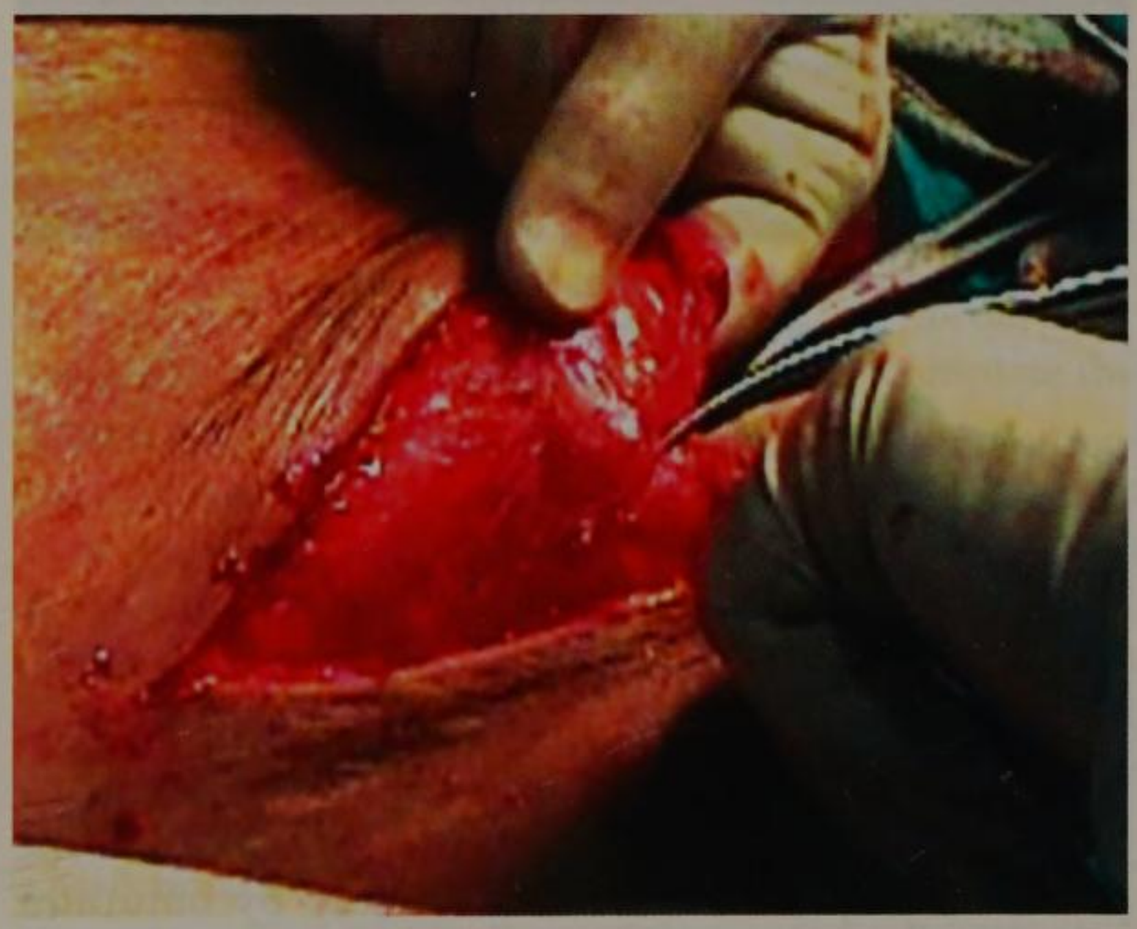

Fig. 30.3: The muscles along with fascia transversalis are being cut

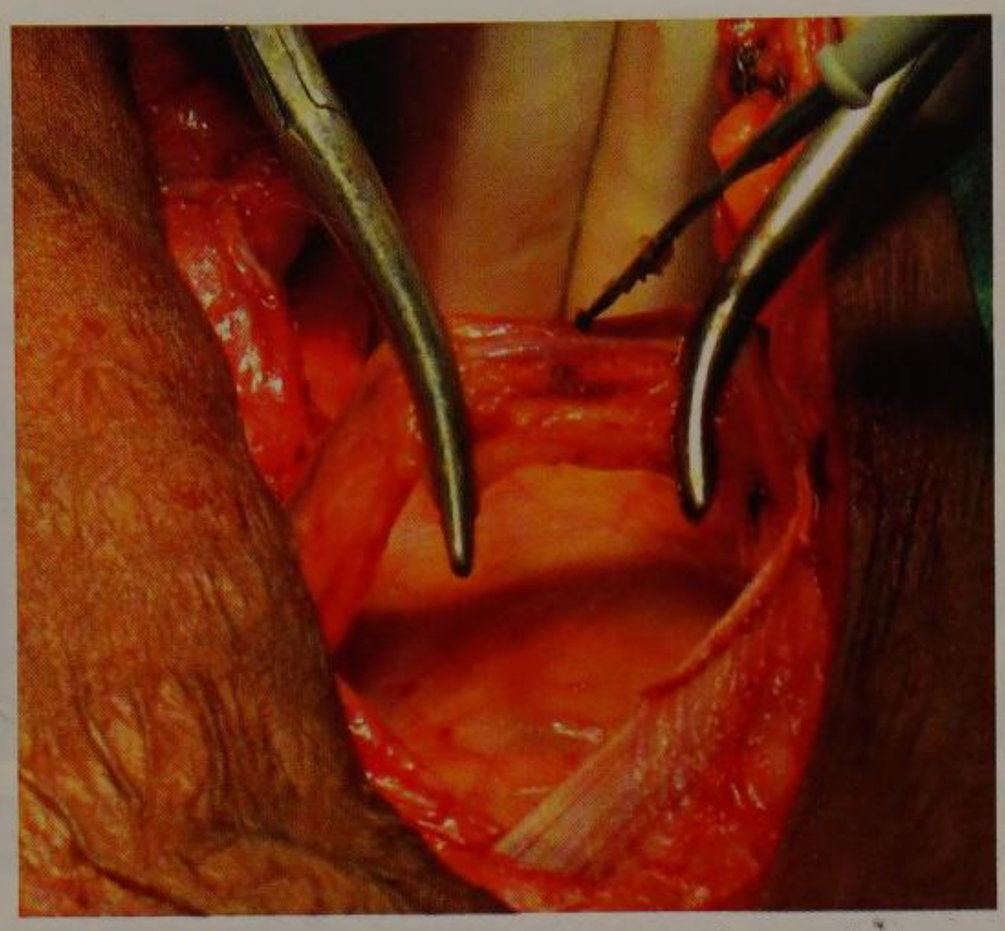

Fig. 30.4: Inferior epigastric vessels are being clamped and cut

Fig. 30.6: Further mobilization of peritoneum is done medially to exposed the external iliac, internal iliac and common iliac vessels. Ureter is seen retracted medially

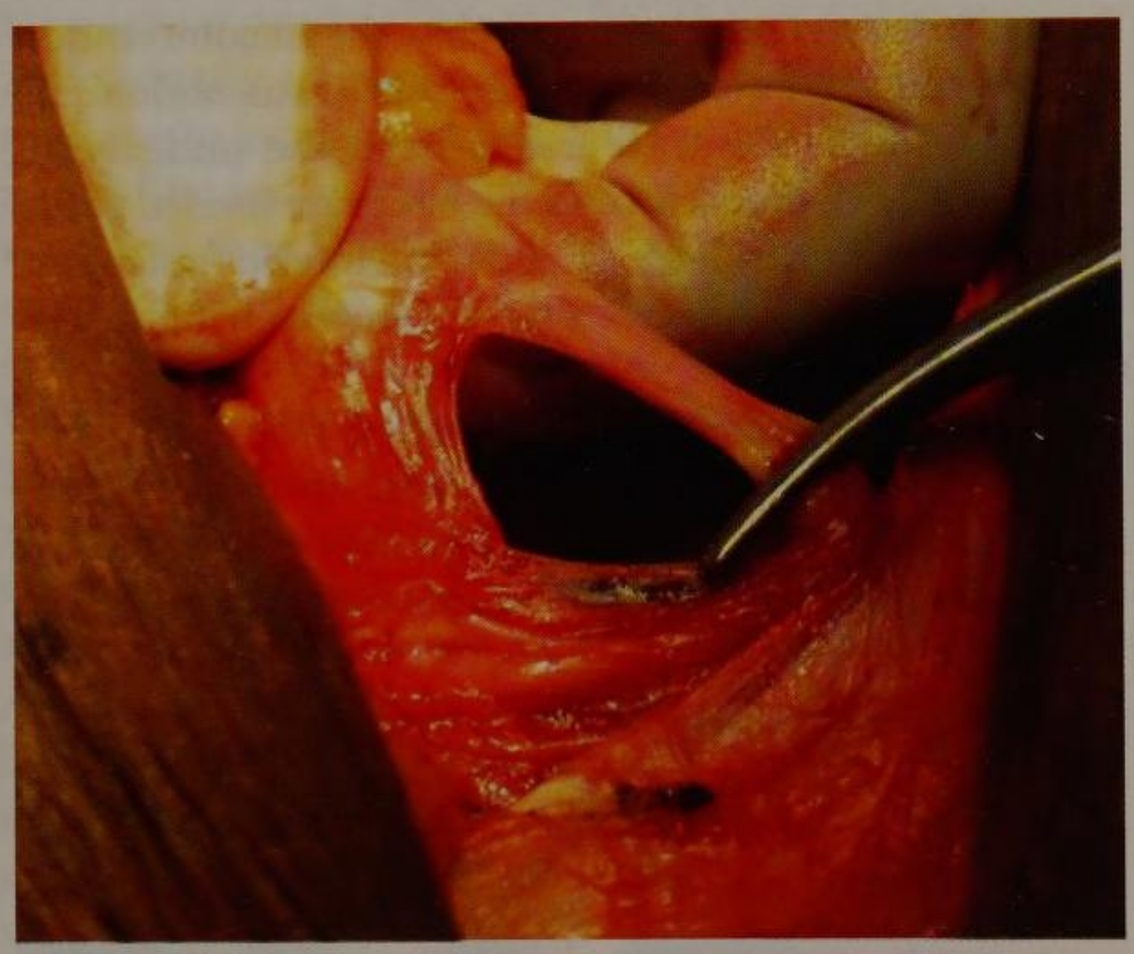

Fig. 30.5: Round ligament is clamped and cut at its entrance to inguinal canal

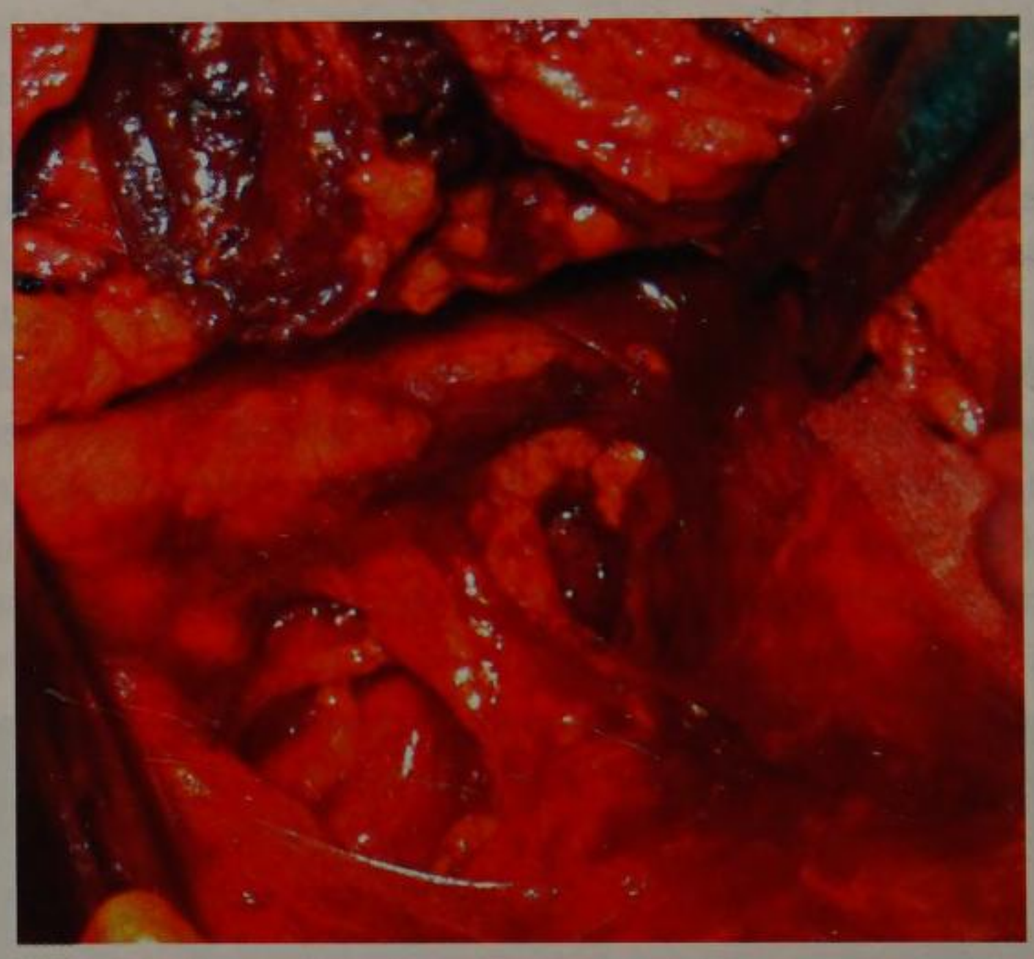

Fig. 30.7: Paravesical and pararectal spaces are being developed. The Mackenrodt's ligament is seen in the middle

peritoneum (Fig. 30.5). Round ligament is cut between clamps and ligatured. The peritoneum is mobilized and pushed medially till the common iliac vessels with their bifurcations into external and internal iliac vessels are exposed (Fig. 30.6). The ureter is seen to be attached to the peritoneum medially.

The paravesical and pararectal spaces are formed by blunt dissection with the index finger (Fig. 30.7). The paravesical space is bounded laterally by obturator internus and medially by the bladder and its pillar. The pararectal space is limited by the rectum and ureter medially and the internal iliac vessels laterally. The Mackenrodt's ligament forms the boundary between the two spaces.

The pelvic lymph node dissection is started by incising the perivascular fibroareolar tissue around external iliac artery. A fairly constant gland is found at the exit of the external iliac artery from the pelvic cavity (Fig. 30.8). Starting from that the entire chain of glands on the external iliac vessels along with the fibroareolar tissues are taken out leaving the vessels bare. The vessels should be retracted medially to take out the nodes lateral

Fig. 30.8: Pelvic lymph node dissection is started by removing the nodes and fibroareolar tissue around external iliac vessels. Note the large node mobilized from the distal end of external iliac artery

to them. The external iliac vessels are lifted up with a vessel retractor to dissect the nodes and the fibro-fatty tissue in the obturator fossa. The nodes have to be carefully dissected from the glistening obturator nerve and the obturator vessels (Fig. 30.9). The internal iliac nodes are seen at the bifurcation of the common iliac arteries and they should be removed (Fig. 30.10). The common iliac nodes are usually found towards the lateral and posterior aspect of common iliac artery (Fig. 30.11). The ureter is seen crossing the common iliac vessels and

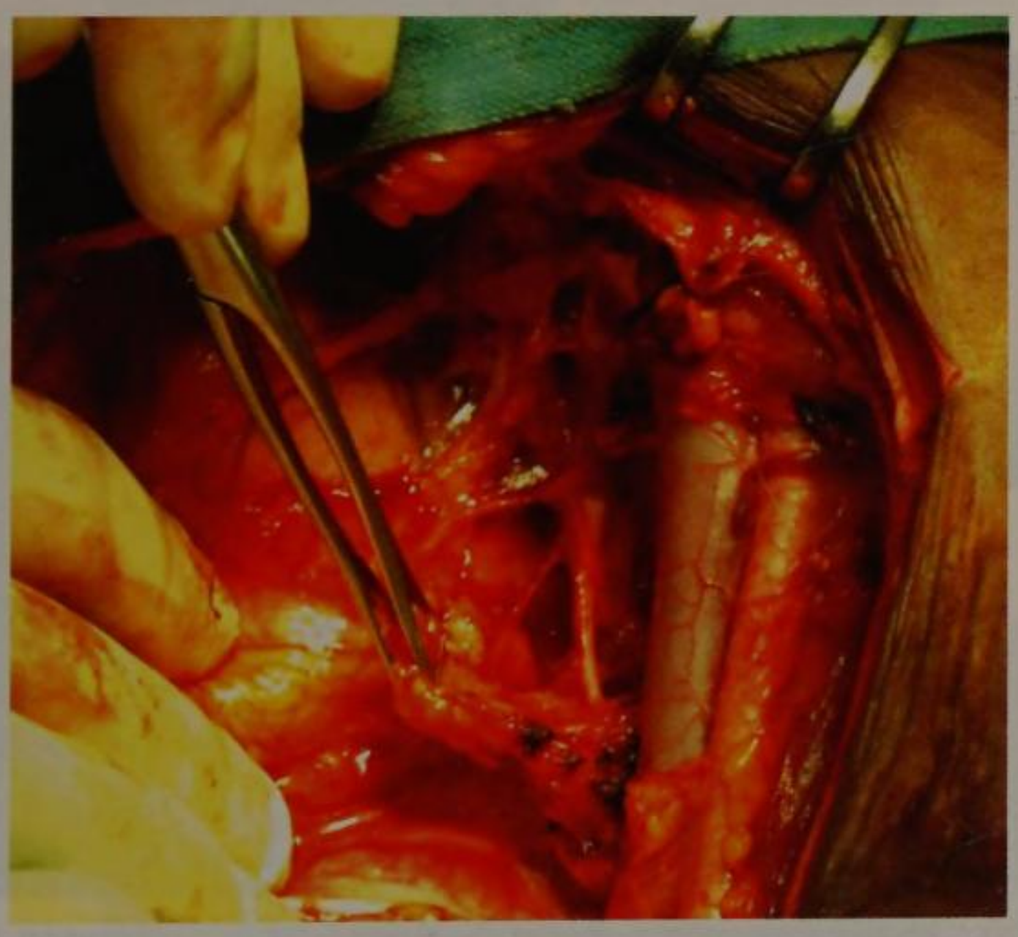

Fig. 30.9: The obturator node is pulled medially to expose the obturator nerve. The obturator vessels lie below the nerve

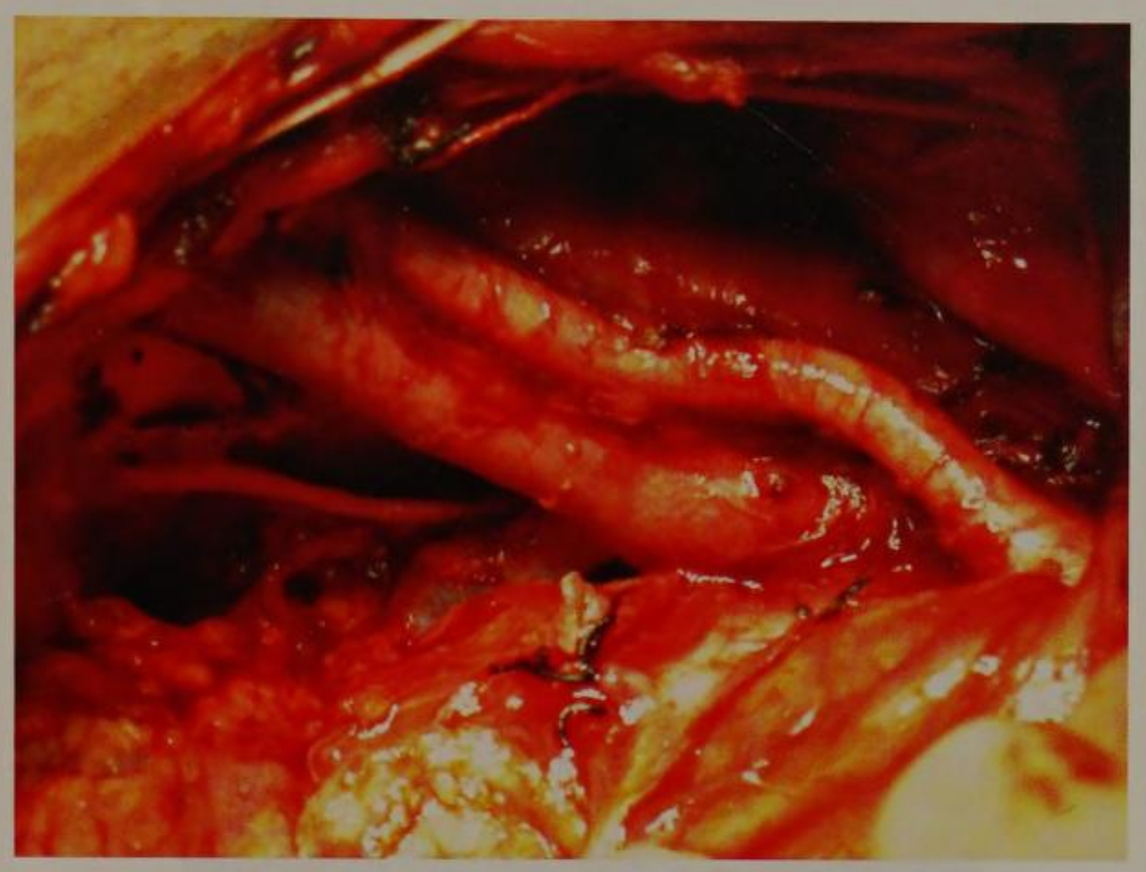

Fig. 30.10: All nodes and fibroareolar tissue are removed from obturator fossa along with those around external and internal iliac vessels. The nerve is seen fully dissected out

Fig. 30.11: Common iliac nodes dissected. The ureter crossing the artery is retracted medially

is retracted medially. The nodes and the fibroareolar tissues around the vessels are dissected to complete the lymph node dissection.

The uterine artery can be seen arising from the anterior division of internal iliac artery as a tortuous vessel often hidden by the obliterated hypogastric artery. The uterine artery is ligatured and cut close to the origin (Fig. 30.12). The distal part of the artery is dissected further medially till the ureteric crossing is reached. The uterine artery forms the roof of the ureteric canal. Dissection of the uterine artery exposes the lower part of the ureter (Fig. 30.13). Rest of the ureteric dissection is done during the vaginal part of the surgery.

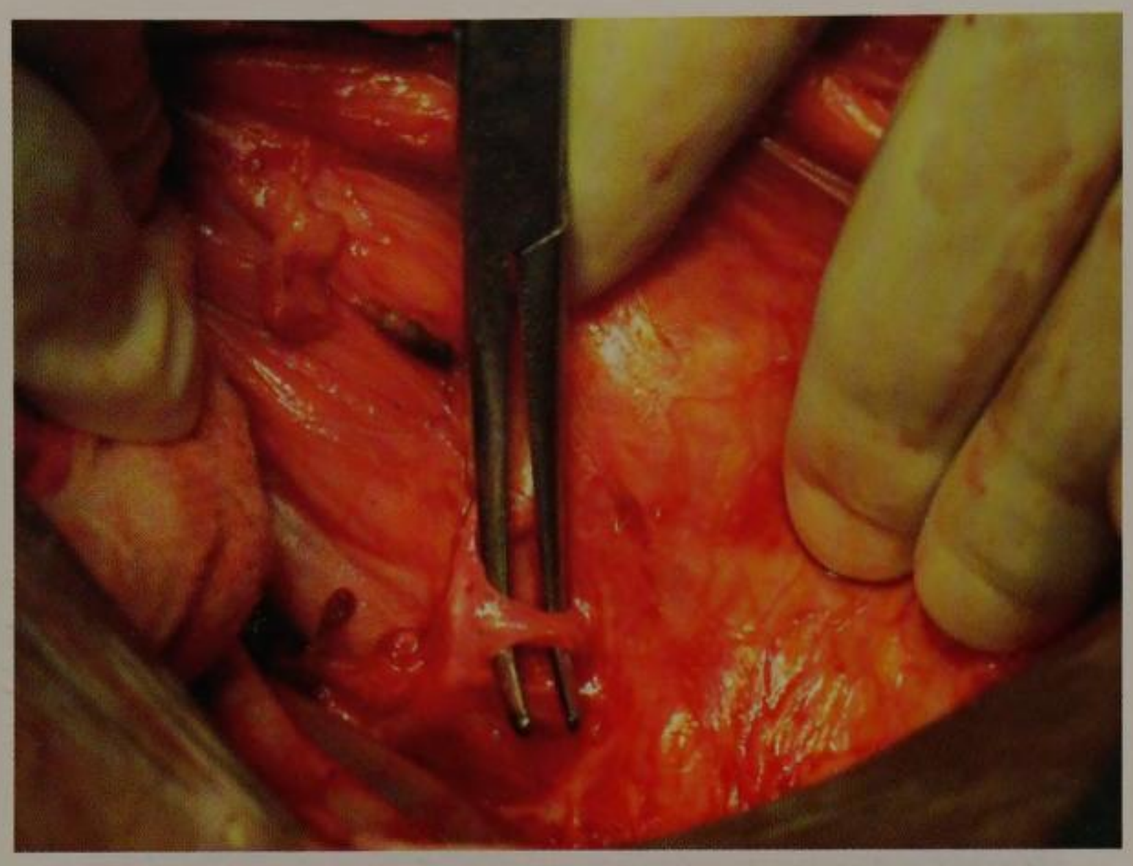

Fig. 30.12: Uterine artery dissected out of its origin from internal iliac artery (anterior division)

Fig. 30.13: After ligating the uterine artery the distal part is dissected medially over the ureter. The terminal part of the ureter has been mobilized

The ovarian vessels are seen running parallel and a little above the ureter. The vascular bundle has to be gently separated from the peritoneum, cut and ligatured (Fig. 30.14).

After confirming proper hemostasis abdomen is closed in layers. The internal oblique, transversus abdominis muscles and the transversalis fascia are stitched together by a continuous stitch. The external oblique aponeurosis is sutured separately and the skin wound is closed.

The entire procedure is repeated on the other side.

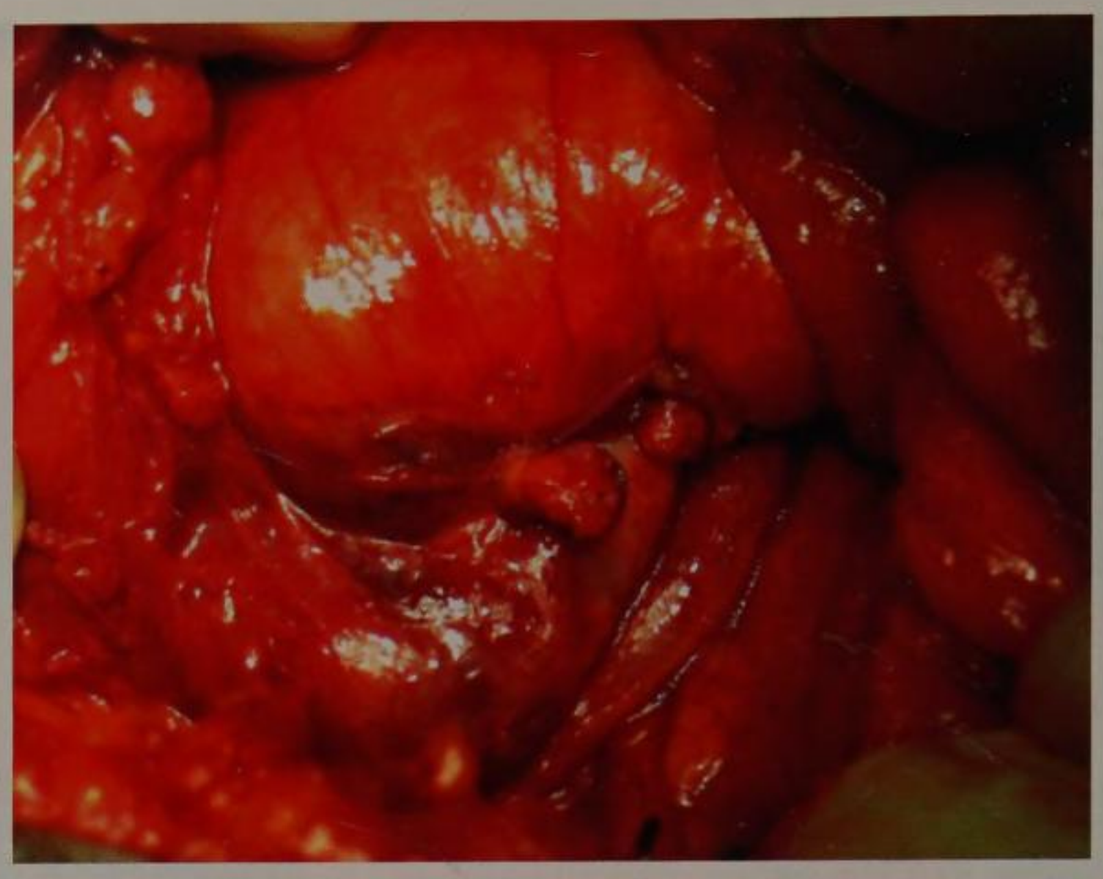

Fig. 30.14: Ovarian vessels are ligated extra-peritoneally. The ureter is seen closed

We have been doing extraperitoneal pelvic lymphadenectomy using Cherney incision. A transverse incision is made about two fingerbreadths above the pubic symphysis. After opening the rectus sheath the rectus muscle is dissected up to its attachment to the pubic bone. The tendinous part of the muscle close to the attachment is cut and the muscle is retracted upwards (Fig. 30.15). Rest of the dissection is same as described before. Both the lateral pelvic walls can be accessed through a single incision saving a lot of time and post-operative discomfort for the patient. During closure of the Cherney incision the rectus tendons are sutured to the anterior rectus sheath near the pubic crest (Fig. 30.16).

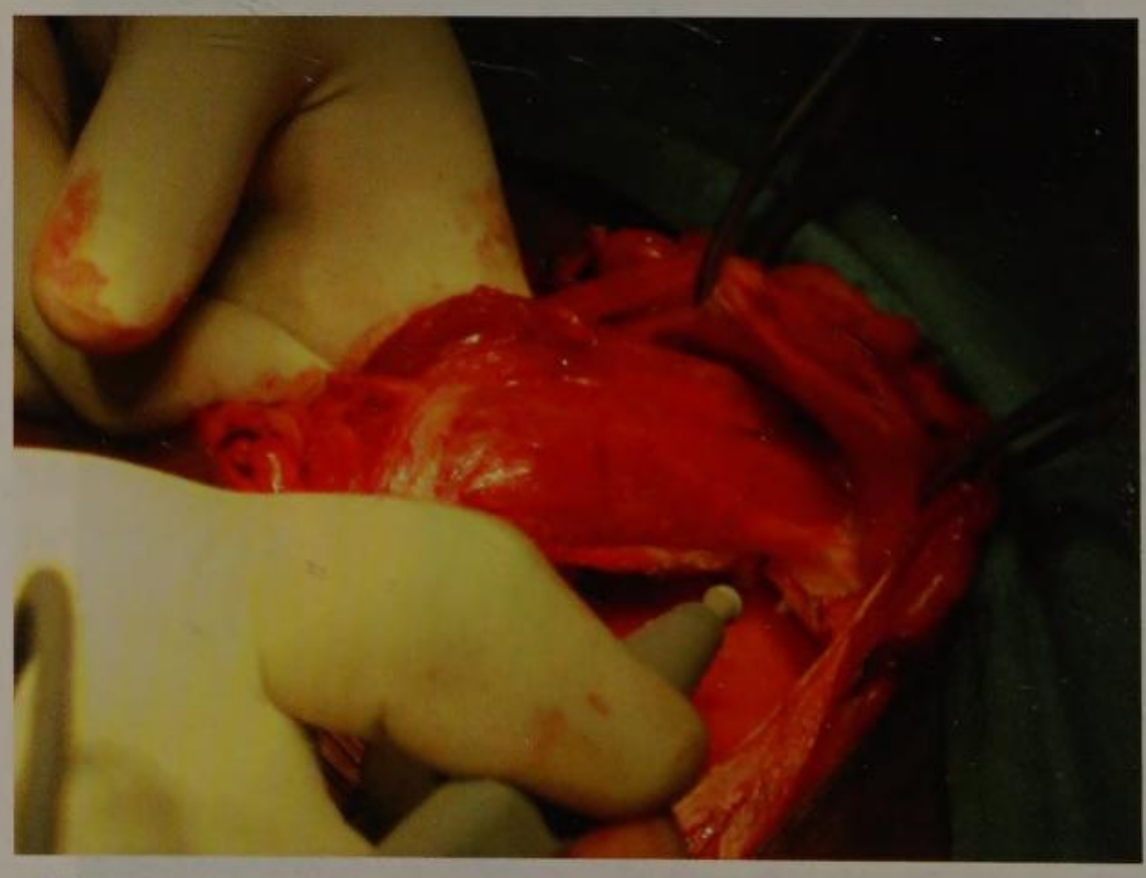

Fig. 30.15: Cherney's incision. Rectus muscle tendon is being cut from symphysis pubis

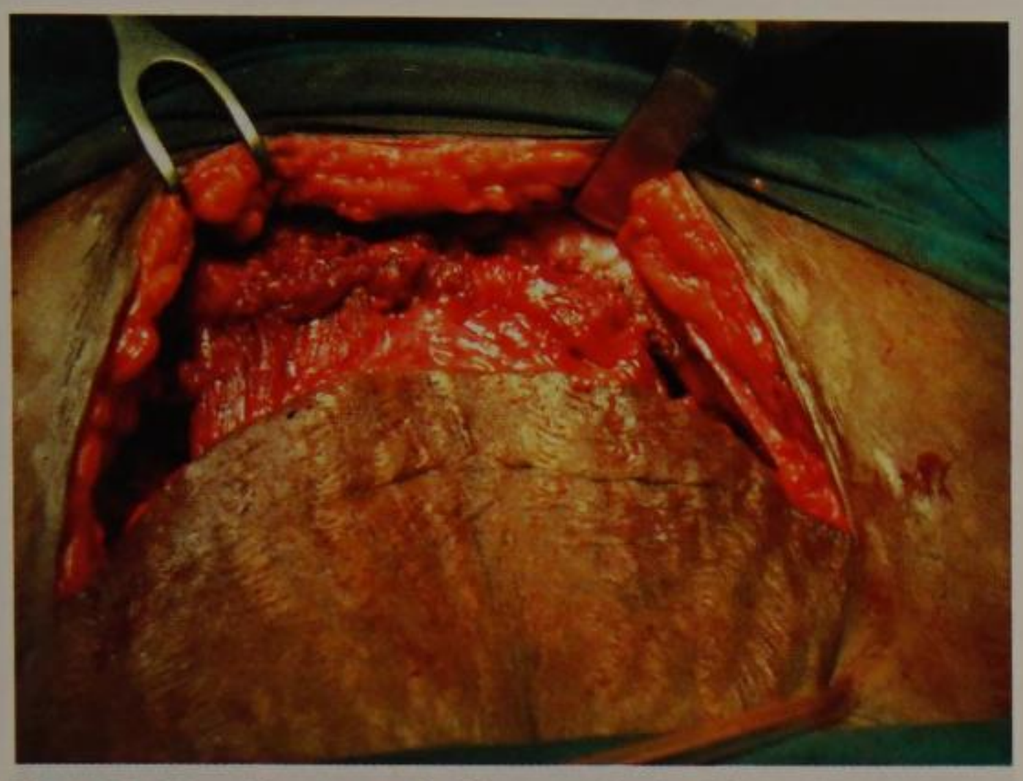

Fig. 30.16: Closure of Cherney's incision. The rectus tendon is stitched to the rectus sheath

Radical Vaginal Hysterectomy

After the abdominal part of surgery the patient is put into lithotomy position. To gain adequate exposure for surgery a deep incision is made through the medio-lateral perineal body, vagina and levator ani muscle. This incision is called Schuchardt's incision (Fig. 30.17). The introitus is held taut by the surgeon applying pressure medially and posteriorly across the perineum and posterior vagina and the assistant applying anterolateral retraction of the left vaginal wall. The incision is made at 5 o'clock position cutting through the perineum between midline and ischial tuberosity curving around the anus. The proximal end of the incision is extended to the upper part of the vagina where it will eventually meet the circular vaginal incision. After the incision is made through vaginal mucosa and fascia the rectum is mobilized medially by blunt finger dissection (Fig. 30.18). The levator ani plate is exposed and cut along the line of skin incision. The top few fibers of the levator are not transected since they will be used as a guide to reconstruct the muscle at the end of the procedure. This exposes the lower part of the pararectal space on the left side. Hemostasis is secured and a self-retaining weighted speculum (Auvard's) is introduced and fixed to the skin (Fig. 30.19).

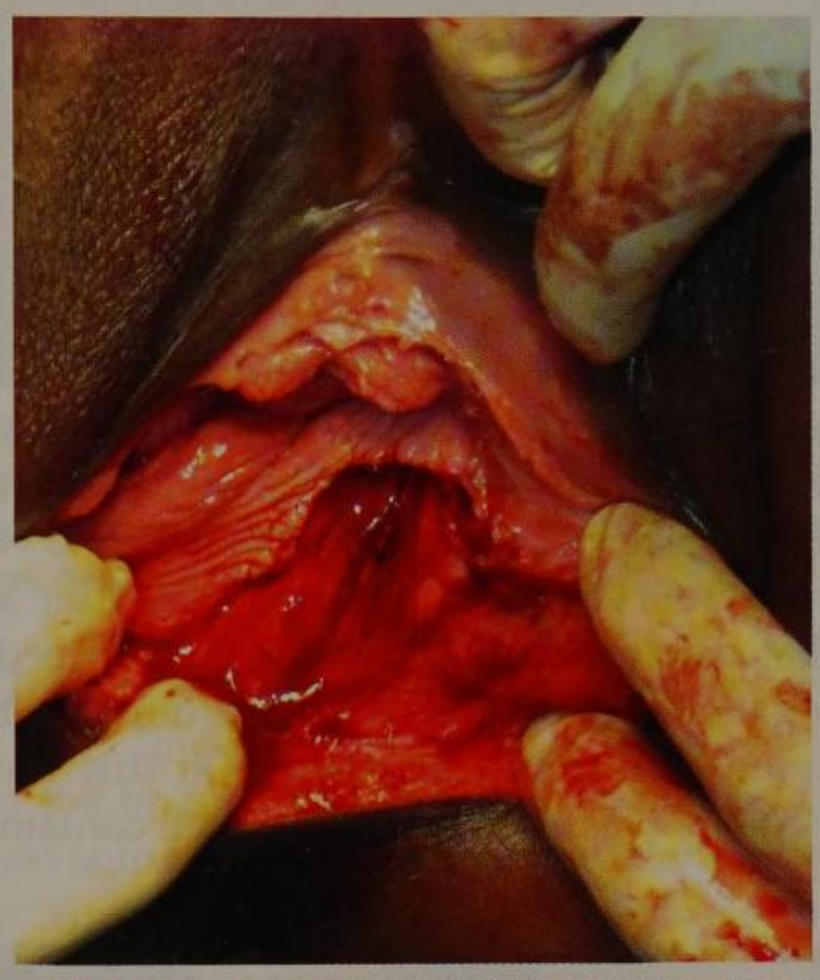

Fig. 30.18: Incision extended to vagina. Rectum separated from the levator muscles

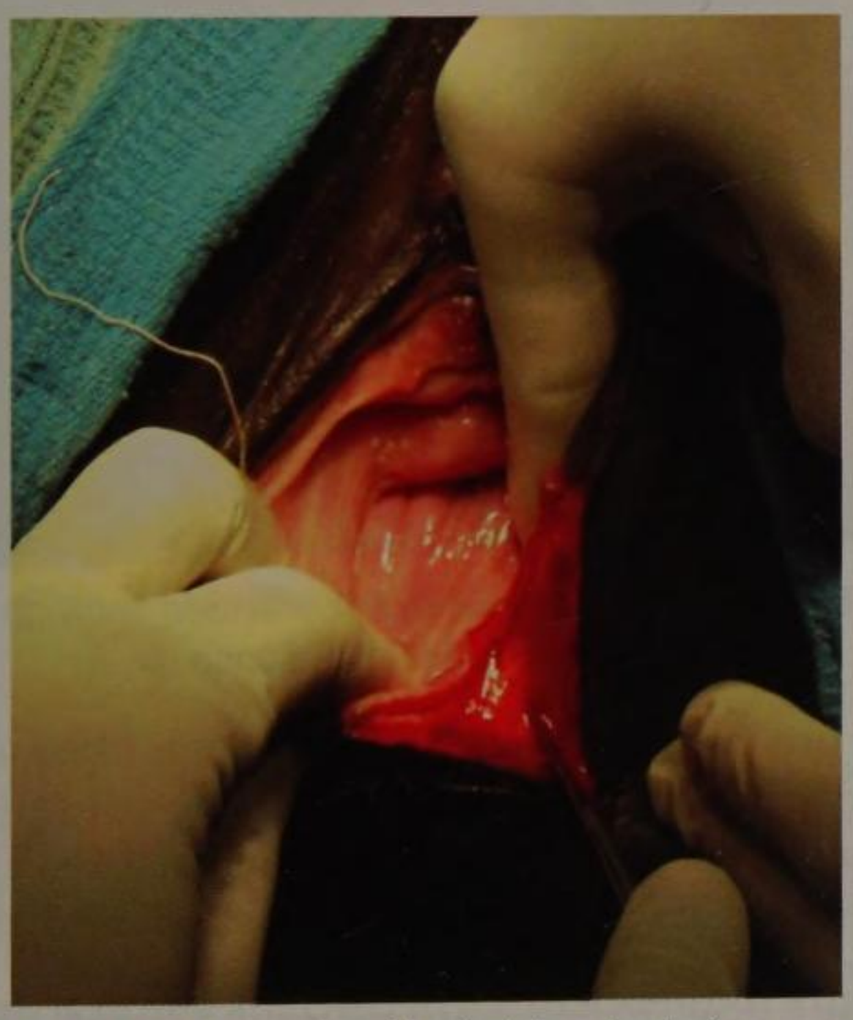

Fig. 30.17: Schuchardt's incision is being made on the perineum

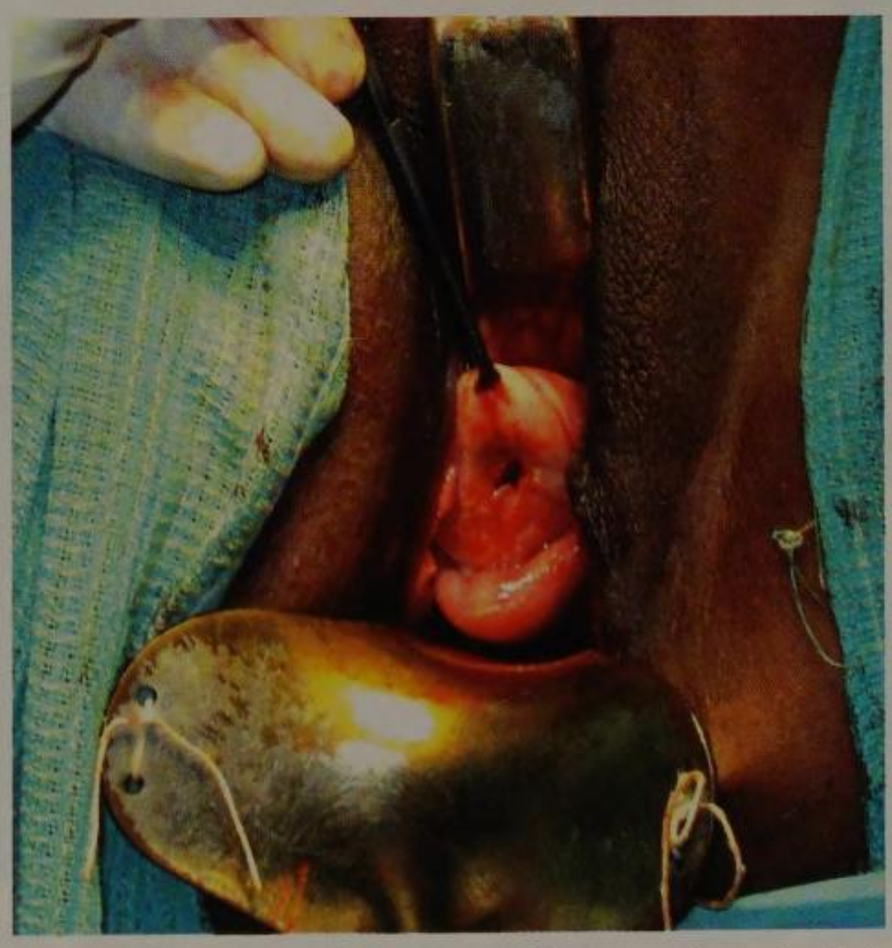

Fig. 30.19: Self-retaining Auvard's speculum is introduced and fixed to skin. The cervix with the growth is exposed

The vaginal cuff is developed by grasping the mucosa overlying the cervix with six long Kocher's clamps producing a circular fold just below the part of vagina that needs to be excised (Fig. 30.20). The cuff should be adequate to cover the cervical growth. A deep circular incision is made through the vagina and paravaginal tissue maintaining tension across the incision line by the counter-pressure of a vaginal retractor (Fig. 30.21). The incision is extended into the vesicovaginal septum anteriorly, rectovaginal septum posteriorly and paravaginal space laterally (Fig. 30.22). The incision should meet the apex of the Schuchardt's incision posteriorly. The vaginal flap is dissected down and closed over the cervical growth using a series of figure of eight sutures. The sutures are kept long so that they can be held by clamps to be used for traction and manipulation. Alternatively, long mouse-toothed clamps can be used to grasp the vaginal cuff (Fig. 30.23).

Next, the bladder has to be dissected up from the vagina, cervix and anterior part of uterus by sharp dissection using the scissors (Fig. 30.24). A counter-traction with a bladder retractor is required to visualize the tissues intervening between the bladder and the cervix that need to be cut. Dissection is continued till the glistening utero-vesical fold of peritoneum is visible. The peritoneum should not be opened at this time. The bladder pillars (vesicouterine ligaments) containing the ureters become prominent if the bladder is lifted up with a retractor. Bladder is mobilized from the sides and from anterior surface of Mackenrodt's ligament to develop the paravesical fossa. The index finger should be inserted into the paravesical space just behind the pubic ramus and with a rolling motion the bladder should be pushed

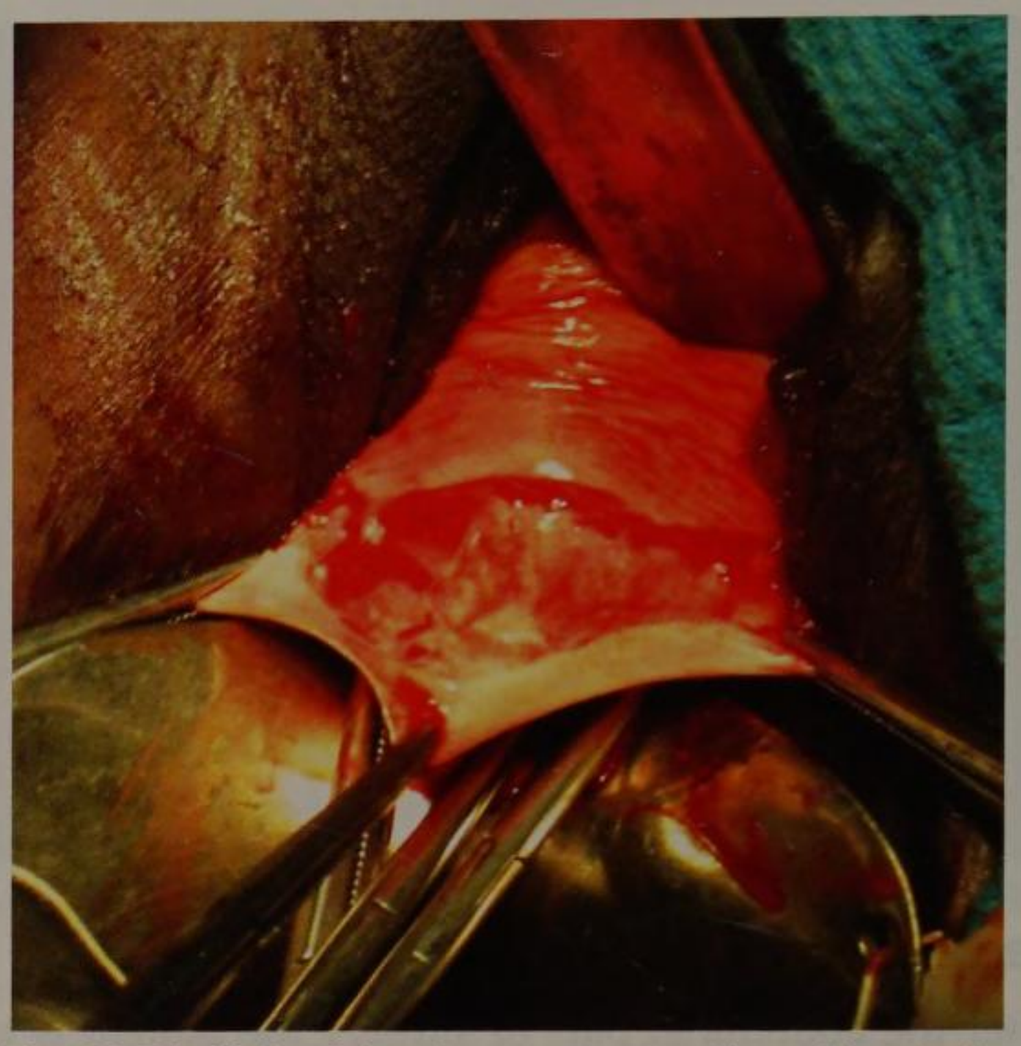

Fig. 30.21: Maintaining the counter-traction with anterior retractor the incision is made through anterior vaginal mucosa and sub-vaginal fascia

Fig. 30.22: Same incision continued through posterior vaginal mucosa

Fig. 30.20: Vaginal cuff is formed by holding the vagina with Kocher's forceps

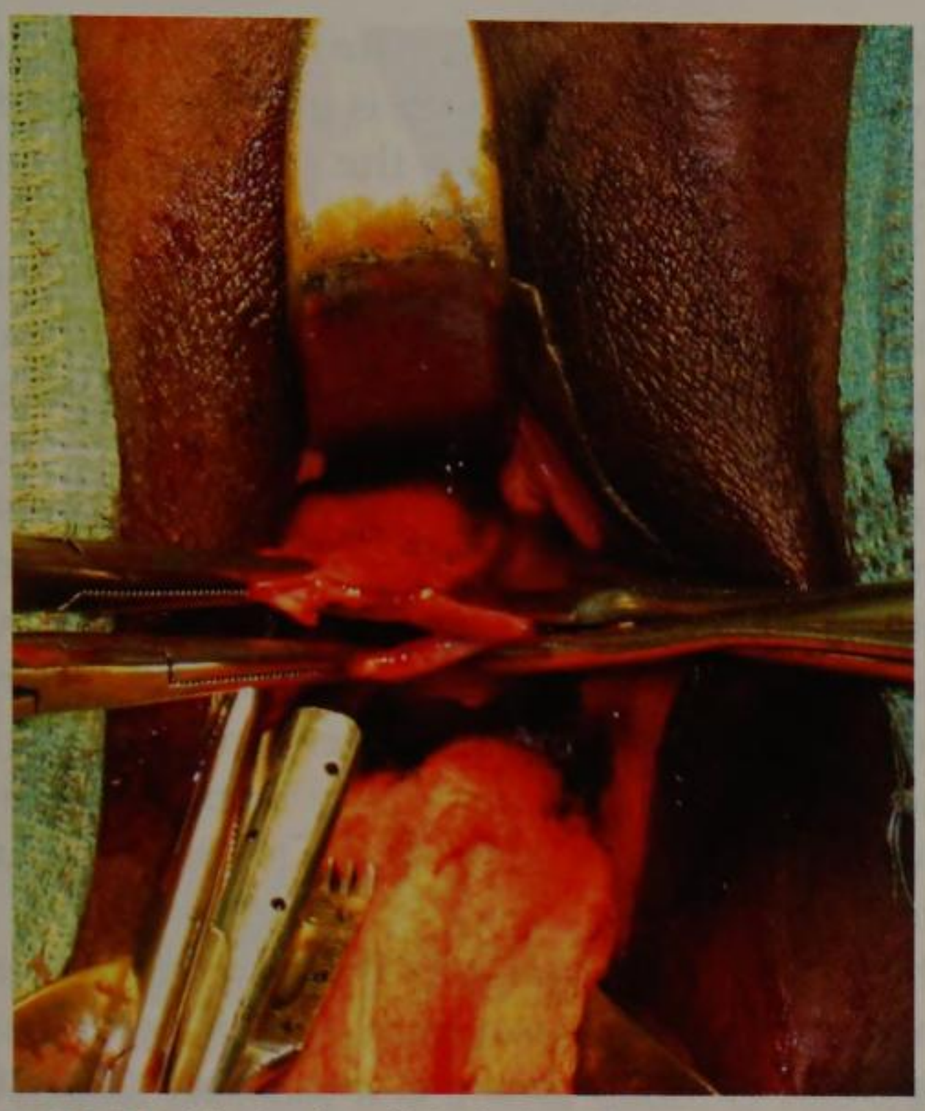

Fig. 30.23: Vaginal cuff is being formed by replacing the Kocher's forceps with Mouse-tooth forceps

Fig. 30.24: Bladder dissected up from the cervix and vagina

medially till the space is completely developed (Fig. 30.25). The vesicouterine ligament (bladder pillar) is clearly exposed now between the uterovesical space medially and the paravesical space laterally. The ligament is firmly attached to the Mackenrodt's ligament and has a bulge at the center due to the presence of the

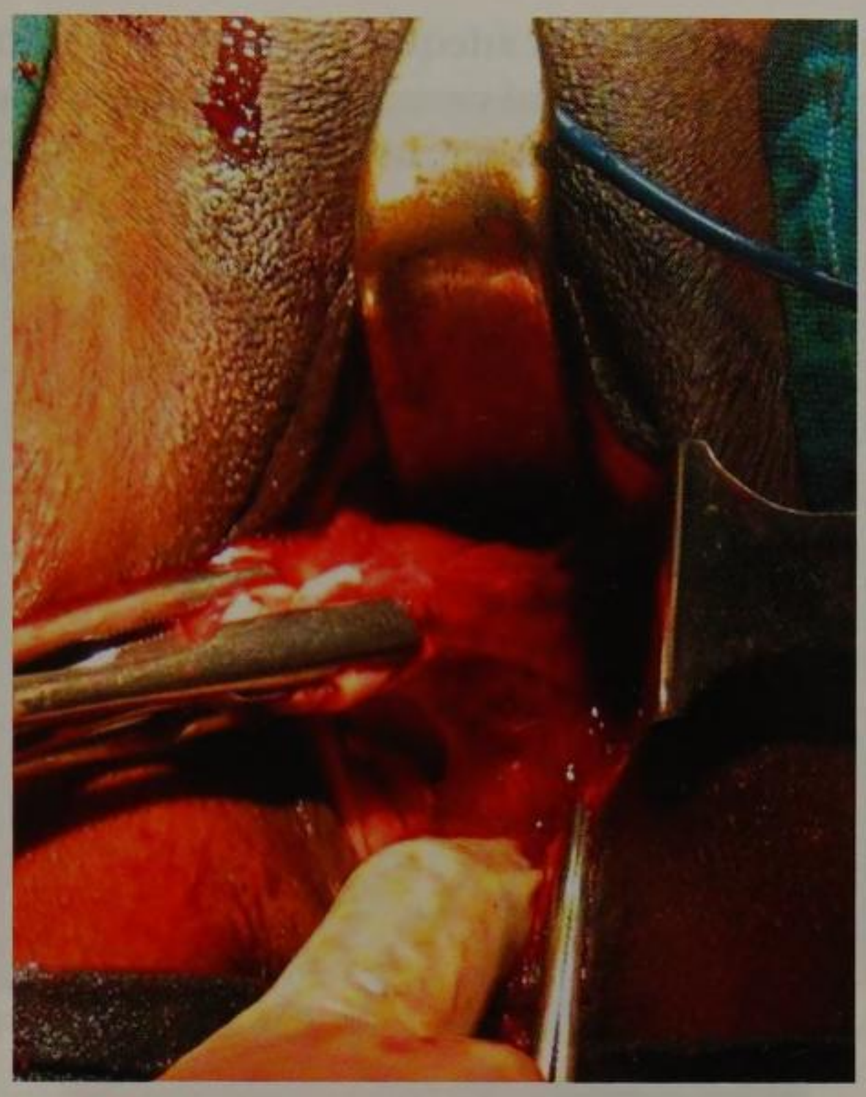

Fig. 30.25: Paravesical space is dissected. The bladder pillar containing the ureter is seen between the utero-vesical space anteriorly and the paravesical space laterally

ureter. The ureter can be palpated between the thumb and the index finger as firm cord that snaps when rolled between the fingers. The vesicouterine ligament is cut with short snips of the scissors on the lateral side till the ureteric tunnel is opened and ureter is exposed (Fig. 30.26). The tunnel is widened with the scissors and the ureter is displaced laterally and upwards. This will

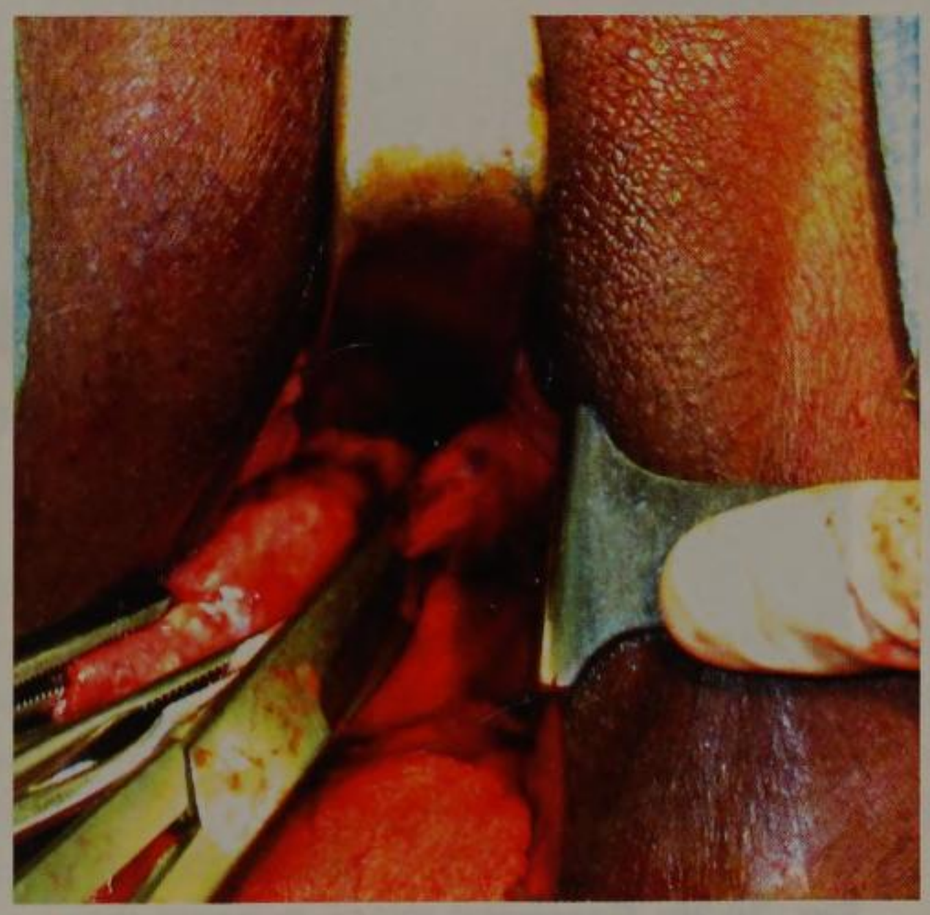

Fig. 30.26: Vesico-uterine ligament (blader pillar) is being cut to expose ureter that is seen bulging

facilitate the removal of adequate amount of parametrial tissue. After dissection of vesical pillar the uterine vessels are seen adherent to the uterus as the ureter is retracted laterally. They are clamped, cut and ligated.

To dissect the rectovaginal and pararectal space the vaginal cuff is pulled upwards. The free cut edge of the posterior vaginal mucosa along with the underlying fascia is dissected from the cervix till the peritoneum over the pouch of Douglas is exposed (Fig. 30.27). The pararectal spaces are fully developed by blunt finger dissection on either side. The peritoneum is cut transversely and a roller gauze is introduced inside the pouch of Douglas to keep the intestines high up (Fig. 30.28).

Fig. 30.27: Posterior vaginal mucosa dissected from cervix till the peritoneal fold is visible

Fig. 30.28: Pararectal space is being dissected. A gauze is inserted through the opened peritoneum of pouch of Douglas

A retractor is introduced into the pouch of Douglas and the uterus is lifted up so that the uterosacral ligament on either side is made prominent. The ligament is dissected from its medial peritoneal attachment. The rectum is pressed down with finger and the uterosacral ligaments are divided on either side as posteriorly as possible (Fig. 30.29). They are divided upto the level of Mackenrodt's ligaments. The ureters are still adhered to the posterior lip of the broad ligament and are lying close to the uterosacral ligament. The upper part of the ligament should be cut with caution to prevent injury to the ureter.

The uterus is now pulled down by traction on the vaginal cuff and the uterovesical fold of peritoneum is cut open and a roller gauze is introduced (Fig. 30.30). The fundus of the uterus is brought out through the opening and grasped with a tenaculum or a hook (Fig. 30.31). As the fundus is pulled downwards and to one side the fallopian tube and the ovary of the opposite side are visualized. The infundibulopelvic ligament is exposed by exerting traction on the tubes and ovaries by Babcock's forceps (Fig. 30.32). The peritoneum covering the ligament is cut with scissors and the ovarian vessel stump (ligatured during the abdominal part of operation) is made visible. The stump is simply pulled out. The

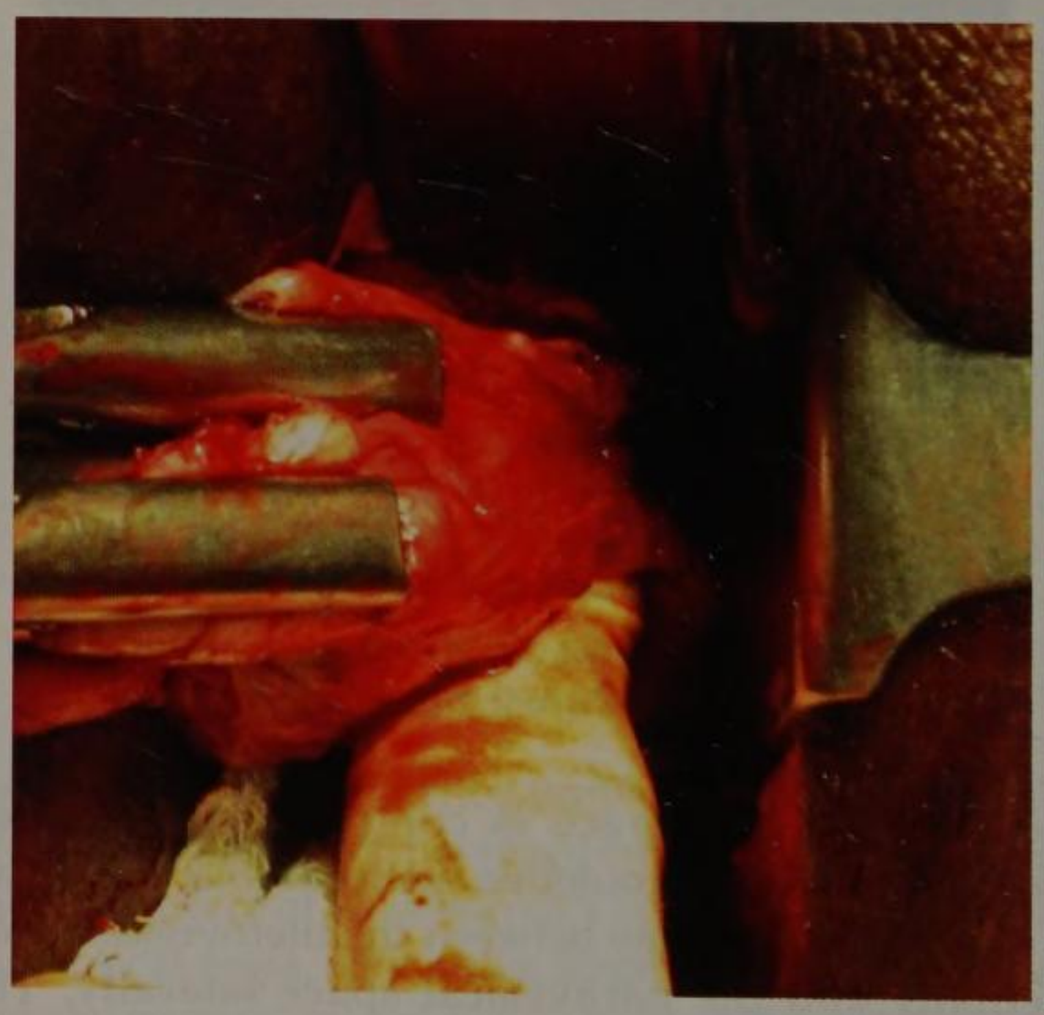

Fig. 30.29: Uterosacral ligament is dissected posteriorly as much as possible before clamping

Fig. 30.30: Utero-vesical fold of peritoneum is opened anteriorly and a roller gauze is inserted

Fig. 30.31: Uterus delivered using a hook

round ligament stump is also similarly pulled out after incising the surrounding peritoneum. The uterus now remains attached to the pelvic wall only by the Mackenrodt's ligament. The uterus and cervix are pulled to one side to stretch the ligament on the opposite side. The ligament is clamped and cut as much laterally as possible taking care not to injure the rectum or the ureter (Fig. 30.33). The specimen is delivered after the Mackenrodt's ligament of the other side is cut (Fig. 30.34).

The peritoneum is closed with a purse string suture after taking out the roller gauze. The vaginal opening is

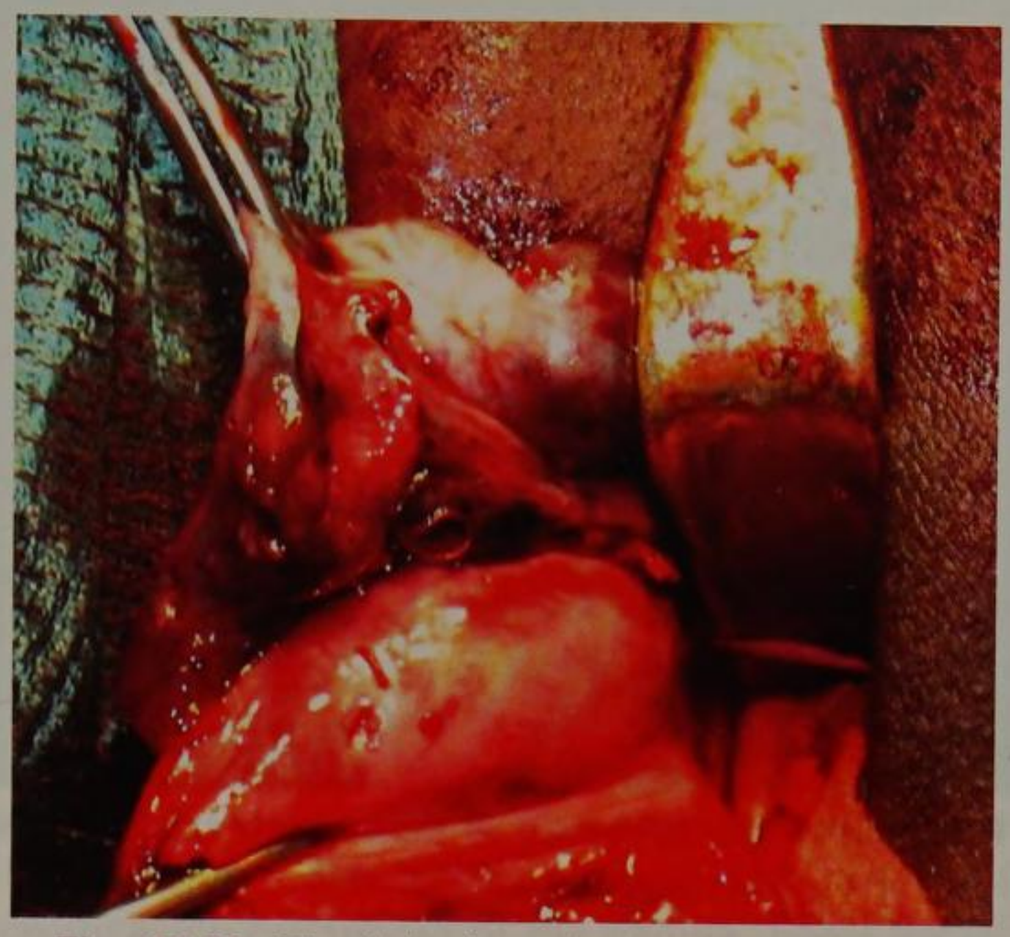

Fig. 30.32: The fallopian tubes and the ovaries are pulled out

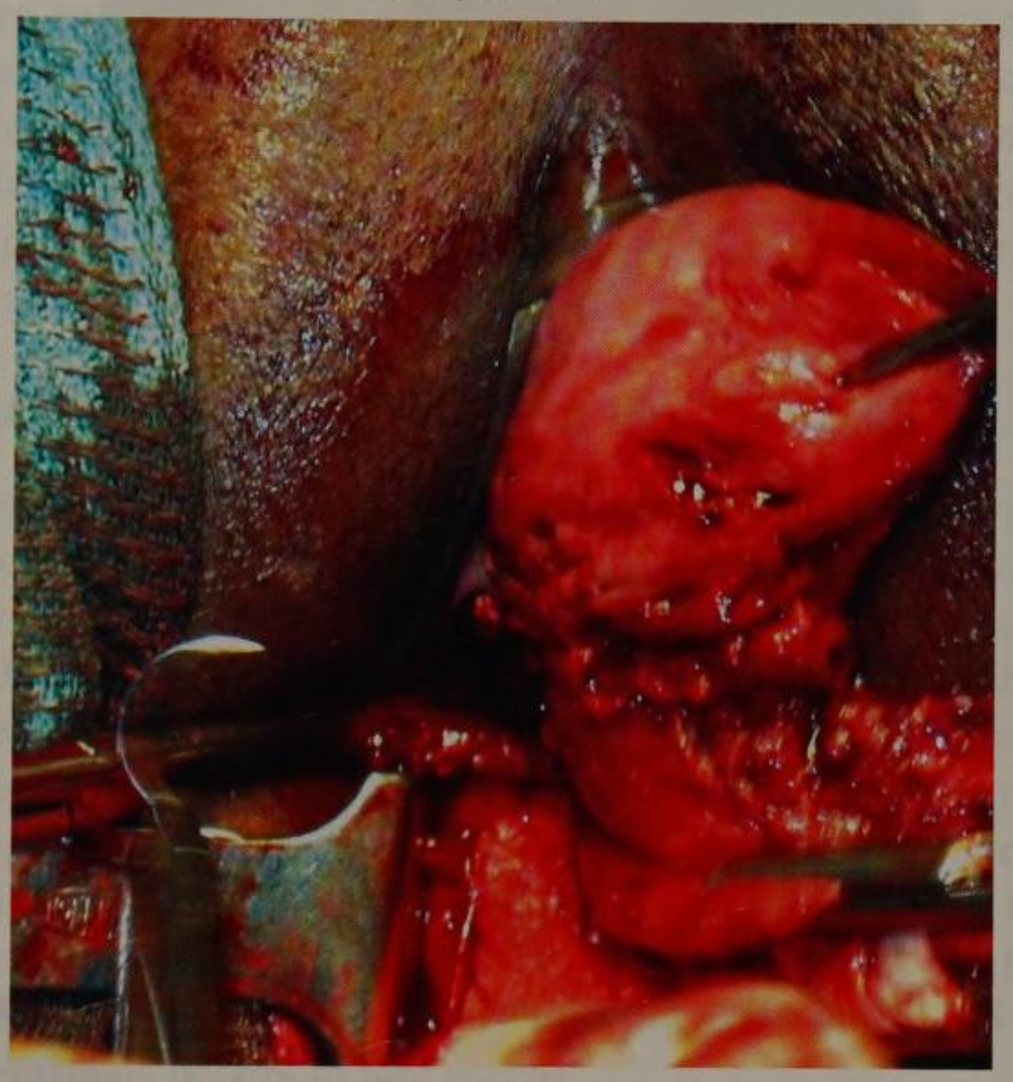

Fig. 30.33: Mackenrodt's ligament is clamped and cut as much laterally as possible

narrowed by interrupted stitches anteriorly and at either lateral angle. If required a roller gauze is introduced through the gap to maintain pressure on the oozing vessels. The incised levator ani muscle is sutured by interrupted stitches. The Schuchardt's incision is closed in layers (Fig. 30.35).

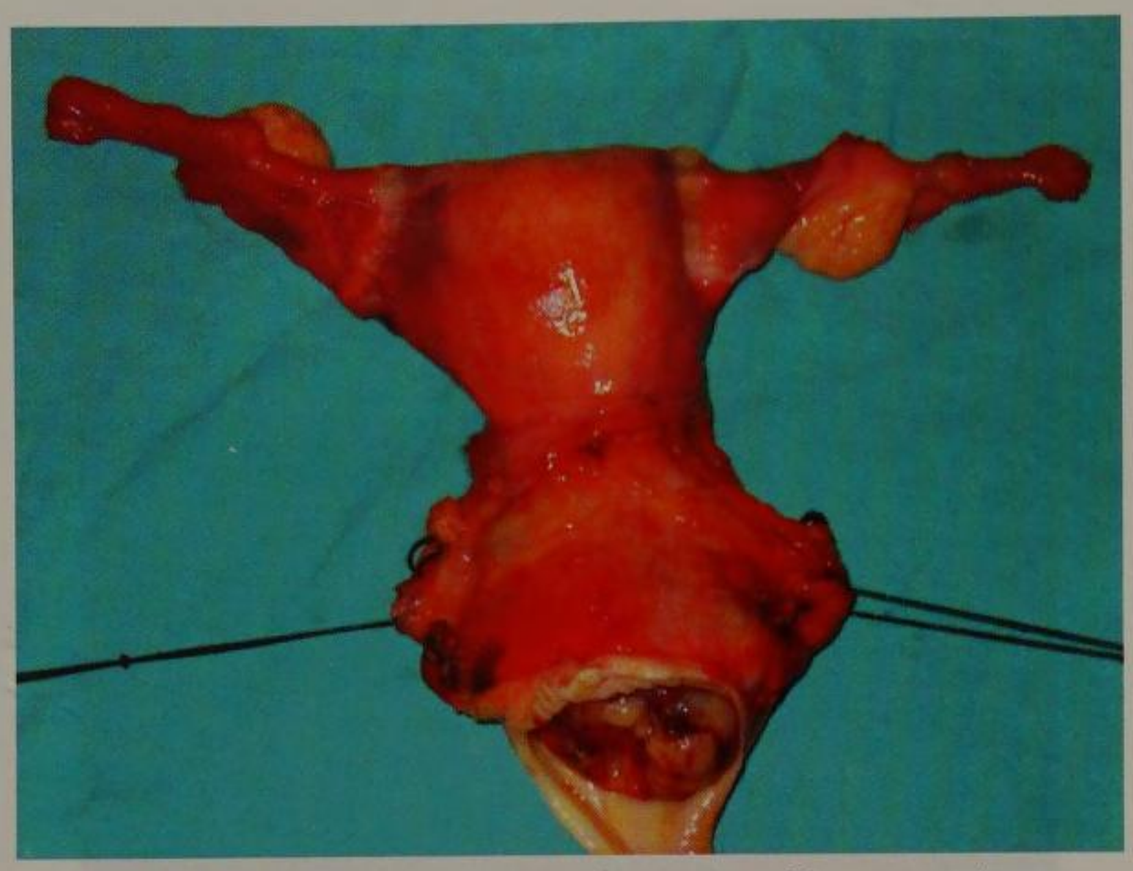

Fig. 30.34: The specimen of uterus with appendages and the vaginal cuff

Fig. 30.35: The Schuchardt's incision is being closed

CONCLUSIONS

With laparoscopic gynecologic surgery becoming popular for lymph node resection, a re-emergence of radical vaginal hysterectomy may occur in the future. This technique is practised by only a few surgeons today and surgical skills required for this procedure need to be revised. The chapter describes in detail with vivid illustrations both the extraperitoneal lymphadenectomy and the radical vaginal surgery.

Key Points

1. For extrapelvic lymphadenectomy 2 separate incisions are given in the abdomen one on each side.
2. After retracting abdominal muscles the round ligaments are cut and iliac vessels are exposed.
3. Pelvic lymph nodes are dissected from iliac and obturator vessels.
4. Uterine and ovarian vessels are cut and ligated and the abdominal incision is closed.
5. For performing vaginal hysterectomy Schuchardt's incision is given for better visualization.
6. A good vaginal cuff is developed, vaginal flap is dissected down and closed over cervical growth.
7. Bladder dissection is completed anteriorly and paravesical fossa developed.
8. Ureter is palpated, vesico-uterine ligament cut, ureteric tunnel exposed and widened and ureters displaced laterally and upwards.
9. Rectovaginal and pararectal spaces are developed and uterosacral ligaments exposed taking care of the ureters.
10. Peritoneum is closed, vaginal opening narrowed and vagina packed.

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Vaginectomy

K Chitrathara, Namrata Kachhara

INTRODUCTION

Vaginectomy is indicated in preinvasive and early invasive carcinoma of the vagina. With the strict criterion used in the diagnosis, the actual incidence of vaginal carcinoma is very rare. Consensus as to the proper treatment of vaginal carcinoma is lacking, mainly because of the rarity of the disease. The most commonly used treatment modality is radiotherapy. In practice the commonest indication for vaginectomy among gynecologists and gynecologic oncologists are carcinoma of uterine cervix involving vagina or a co- existing pre-invasive lesion of vaginal mucosa. Other indications are instances of vulvar cancer extending to vagina, rectal and bladder cancer involving vagina or to prevent close margins in above situations. Vaginectomy is also done as a part of pelvic exenteration in primary vaginal carcinoma and cancers of adjacent organs.

Vaginectomy for invasive vaginal carcinoma is radical as opposed to simple vaginectomy for VAIN. Vaginectomy may be partial, subtotal or total depending on the extent of the disease, how well-circumscribed the lesion is, and whether it is multifocal. The excision should include 2 cm of normal vagina distal to the lesion and the entire vagina proximal to the lesion. If more than a third of the upper vagina is removed, then vaginal reconstruction using a split-thickness skin graft is required in order to have normal sexual function.

VAGINAL INTRAEPITHELIAL NEOPLASIA AND MICROINVASIVE VAGINAL CARCINOMA

Papanicolaou smears, colposcopy, colposcopy directed biopsy are diagnostic procedures. One significant difference between vaginal and cervical squamous intraepithelial neoplasia is that there is less vascular atypia in the vagina than the cervix. VAIN 3 may be associated with unsuspected invasion so is best treated with excision.[1] Peters et al suggested criteria for microinvasive carcinoma of the vagina. Focal invasion associated with VAIN 3, no lymphovascular invasion, free margins on partial or total vaginectomy and a maximum depth of invasion of < 2.5 mm measured from overlying surface.[2] Eddy et al reported six such patients who met these criteria and were treated by partial or total vaginectomy, in one case out of six, bladder recurrence developed at 35 months.[3]

Squamous Cell Carcinoma of the Vagina

Squamous cell carcinoma is by far the most common type, accounting for 85%-87% of all primary vaginal carcinoma. Grossly, it appears as an ulcerating lesion (50%), a fungating mass (30%), or an annular constricting mass (20%). Secondary infections in an ulcerating tumor are common. The most common site of occurrence is the upper third of the vagina. Because of the thin vaginal wall, squamous cell carcinoma tends to spread early by directly invading the bladder and rectal walls. It also metastasizes through the lymphatics and blood borne metastasis occurs in late stages.

Clear Cell Adenocarcinoma

This is the second most common type and accounts for about nine percent of all primary vaginal carcinoma. The age of presentation is early, usually after age 14 years, and peak incidence is in people aged 19 years.

Verrucous Carcinoma

It is rare in vagina. The response to radiotherapy is said to be poor,[4] spreads superficially, in early stages in later stages extensive infiltration can occur.

Vaginal Leiomyosarcoma

Vaginal leiomyosarcoma is rare. Grossly, it manifests as a bulky submucosal lesion, mainly in the upper vagina.

Melanoma

Mucosal melanomas carries a poor prognosis.[5]

From the above description, it is clear that most of the vaginal malignant lesions are in the upper posterior vagina where it is amenable to surgical treatment, vaginectomy; radical for invasive lesions and simple vaginectomy for preinvasive and microinvasive lesions.

Treatment is individualized and depends on the:

1. Histologic type.
2. Stage of the disease.
3. Location of the lesion.
4. Presence or absence of the uterus.
5. Age and parity of the patient.
6. Prior irradiation.
7. Medical condition of the patient.
8. Risk-benefit analysis of all possible treatment modalities.

Radical surgery varies depending on tumor size and location. Most important factors deciding the surgical outcome in the absence of lymph nodes is adequate local clearance. Small Stage-1 lesions in the upper vagina are treated by radical hysterectomy, subtotal vaginectomy, and pelvic lymphadenectomy.[6] Lymphadenectomy is required to ensure that metastatic disease is not present. If the patient had a previous hysterectomy, then a radical upper vaginectomy with pelvic lymphadenectomy is performed after the paravesical and pararectal spaces are developed to avoid injury to the bladder and rectum, respectively. Each ureter is also dissected out to its point of entry into the bladder. If the lesion is multifocal or if it extends to the lower third of the vagina, inguinal lymphadenectomy should also be performed, and a total vaginectomy is required.

Lesions in the lower vagina are managed by partial vaginectomy, total or partial vulvectomy, and bilateral inguinal lymphadenectomy. Larger and more invasive lesions (> 3 cm) are treated with exenterative surgery. Note that whenever the depth of invasion is questionable or vaginal mucosa is left *in situ* after partial or subtotal vaginectomy, frozen sections should be obtained to exclude lateral superficial spread/deep invasion because the most common site of initial recurrence is the vagina. In total vaginectomy split thickness skin graft is done for vaginal reconstruction.

In general, tumors of the upper posterior wall are more operable because the sigmoid reflects away from the posterior vaginal wall, while the entire length of the anterior vaginal wall stays in close proximity to the bladder.

In lesions not suitable for conservative radical surgery, vaginectomy is performed as a part of exenterative procedures. Pelvic exenteration can be either total where bladder and rectum are removed, anterior where uterus and vagina are removed with bladder and in posterior exenteration rectum is excised along with the offending vaginal lesion. It could be supralevator exenteration where the rectum and anal canal below the level of levator ani is not removed. Extension of the tumor into the pelvic sidewall is a contraindication to the procedure. Unfortunately, neither CT scanning nor MRI is sensitive and specific enough to rule out pelvic sidewall involvement. So preoperative assessment becomes important.

A neovagina is ideally performed. Contrary to the neovagina constructed in the anterior exenteration in which the posterior vaginal wall is preserved, the omentum in case of posterior exenteration might be insufficient for a split-thickness skin graft. For this reason, the rectus abdominis muscle or the gracilis muscles in the medial thigh are good alternatives as a source of a myocutaneous flap.

A third myocutaneous flap, the vulvobulbocavernosus pedicle, was described in 1984 by Hatch[7] in the construction of a neovagina after exenteration. Originally, this pedicle was used in repairing radiation-induced recto-vaginal fistulae (Martius procedure). Tunneled under the skin just lateral to the posterior introitus, and once inside the perineal defect, they are sutured together forming a neovagina.

In clear cell carcinoma the therapeutic considerations are very similar to those for patients with squamous cell carcinoma, although most patients are young and every effort should be made to preserve functional ovaries and vagina. Surgery is the primary treatment modality.

Preoperative Work-up

All staging investigations are as per the recommendations by FIGO and AJCC.

It is better to have CT or MRI to get more accurate picture of pelvis to prevent an unjustifiable extensive surgery. Oudouxa et al suggested that F-18 fluorodeoxyglucose positron emission tomography (FDG-PET)

provides a more accurate assessment of the extent of disease in a patient with malignant melanoma as compared to conventional methods. FDG-PET is a useful investigation prior to exenterative procedures.[8]

Baseline levels of carcinoembryonic antigen (CEA), CA-125, and squamous cell carcinoma antigen are recommended to assist in postoperative follow up.

Preoperative Preparation

1. Adequate counseling.
2. Prophylactic antibiotics (usually first or second generation cephalosporins and metrogyl) are administered IV or IM immediately before the operation and continued every 6 hours for 2 additional doses.
3. Thromboembolic prophylaxis, could consist of low-dose heparin (5000 U bid)/low molecular weight heparin, pneumatic compression, or both.
4. Bowel preparation if total vulvectomy is planned. It is a must before exenteration.

Radical Vaginectomy

When the uterus is *in situ*, radical vaginectomy can be approached vaginally or abdominally. If two-thirds of the vagina needs to be removed, however, a combined approach is required to mobilize the distal vagina. In patients with previous hysterectomy, the abdominal approach or a combined approach is required because of a higher risk of injury to the ureters during resection of the cardinal ligaments and the proximal bladder pillars.

The objective of combining with radical hysterectomy not only technically facilitates radical vaginectomy but also oncologically, it is easier to get wider clearance for the vaginal lesion. At laparotomy thorough abdominal exploration is done to exclude intraabdominal dissemination.

The retroperitoneum is entered through the round ligaments on both sides (Figs 31.1 and 31.2). Once the ureter is identified as it crosses the pelvic rim, the pelvic spaces are developed (Figs 31.3, 31.4, 31.8). The vesicouterine fold of the peritoneum is opened, and the bladder is dissected away from the cervix and upper vagina. The ovarian vessels in the infundibulopelvic ligament are ligated (Fig. 31.5). Pelvic lymph node dissection is done (Fig. 31.6). The uterine artery is ligated at its origin from the superior vesicle or internal iliac

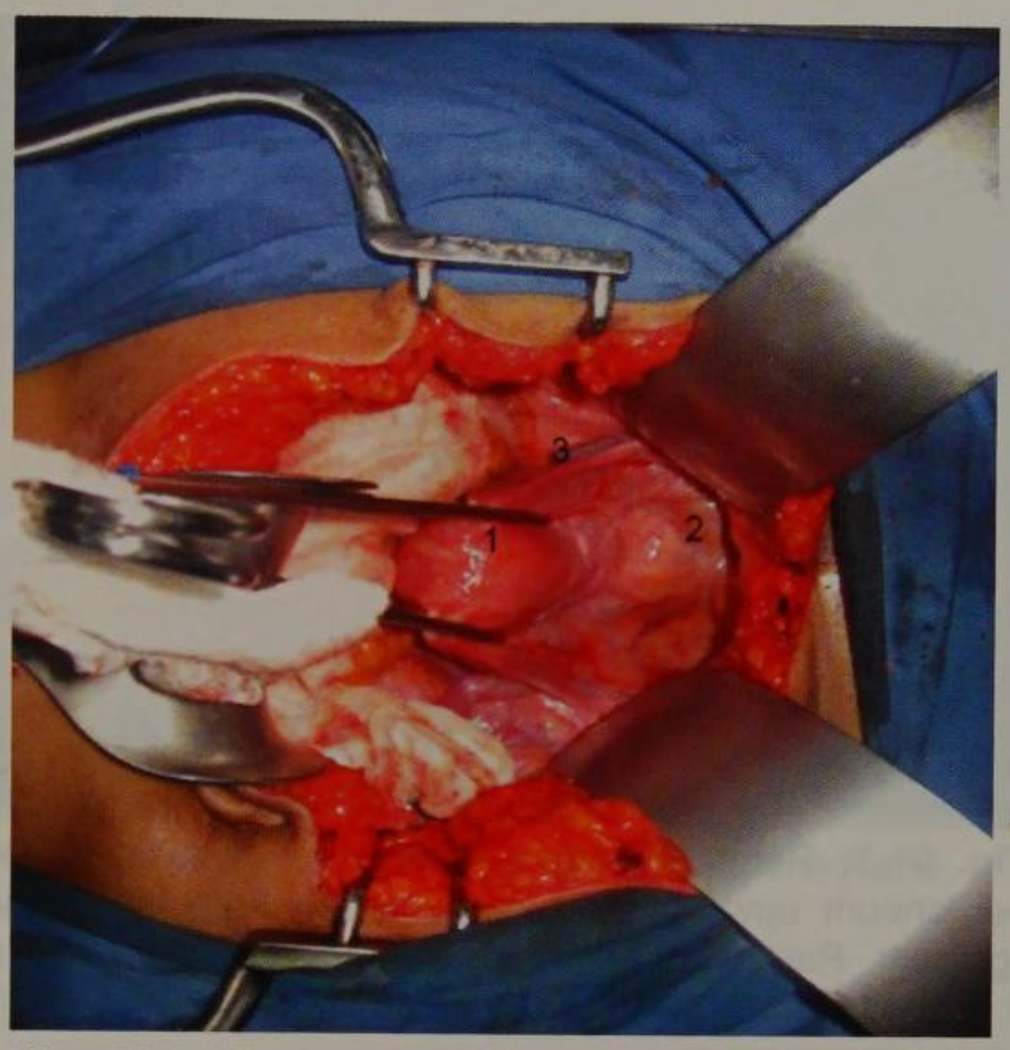

Fig. 31.1: Radical hysterectomy and vaginectomy, abdominal dissection. Intestines are packed away from operative field. Uterine cornual clamps are applied
1. Uterus
2. Cervix
3. Round ligament

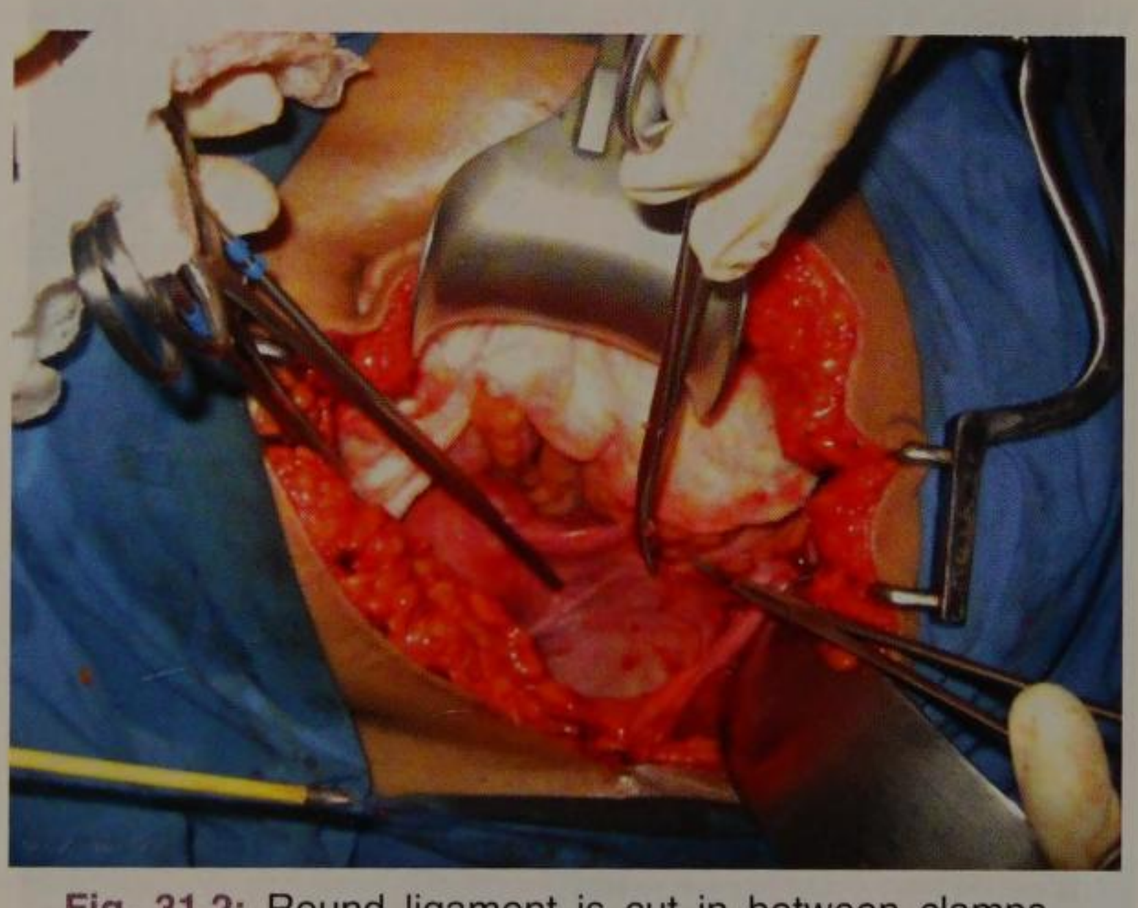

Fig. 31.2: Round ligament is cut in between clamps
1. Round ligament

artery and then mobilized over the ureter (Fig. 31.7). The uterine veins are clipped to avoid excessive bleeding.

The anterior vesicouterine ligament, which forms the roof of the ureteric tunnel, is carefully dissected. And ureters are dissected away up to the bladder. There is no

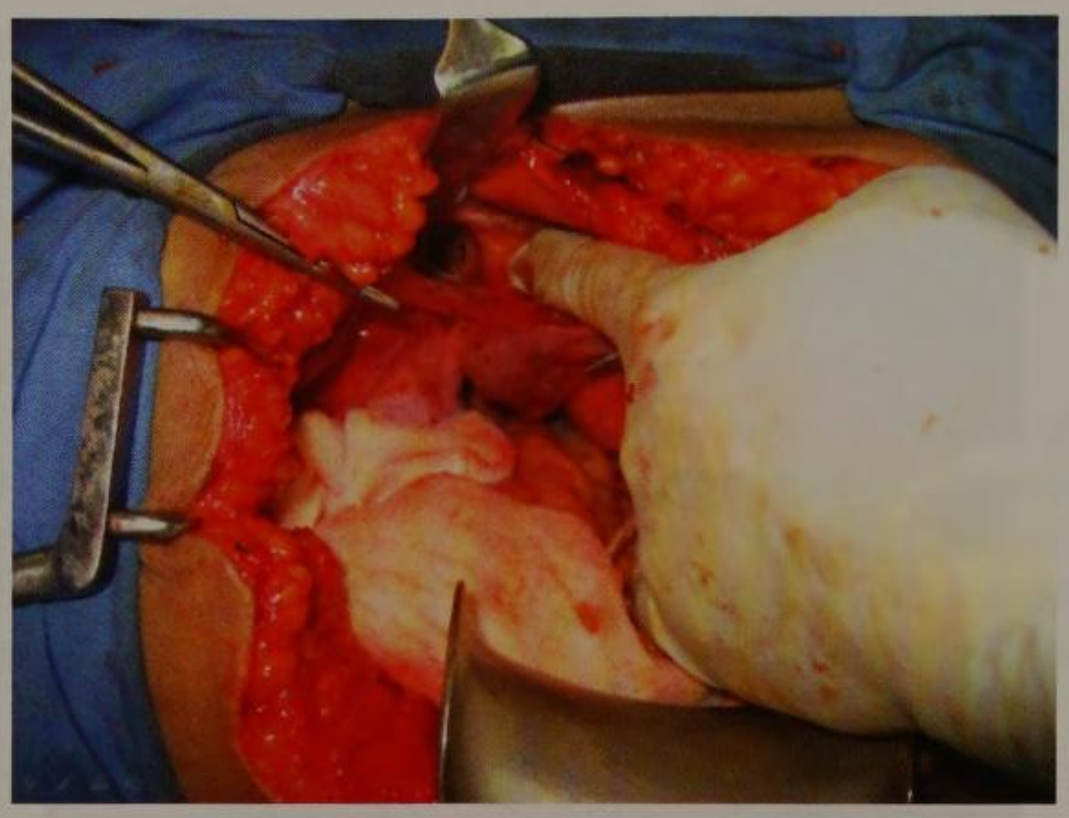

Fig. 31.3: Retroperitoneum is entered by incising the peritoneum upwards and downwards from the round ligament. Paravesical space is developed:
1. Paravesical space

Fig. 31.4: Development of paravesical and pararectal spaces. Proceeding with lymphadenectomy
1. External iliac artery 2. External iliac vein
3. Uterus

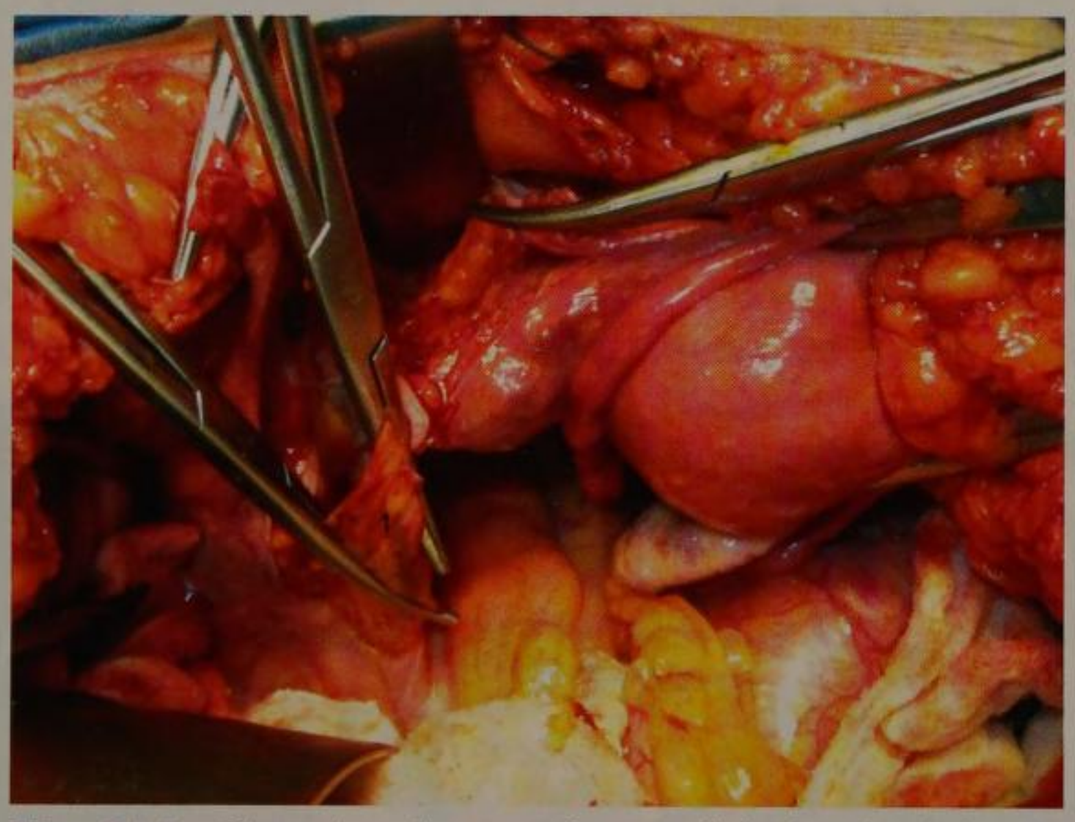

Fig. 31.5: Clamping the ovarian pedicle in the infundibulopelvic ligament
1. Ovarian vessels

Fig. 31.6: Completed pelvic lymph node dissection, proceeding with radical hysterectomy
1. External iliac artery
2. External iliac vein
3. Obturator nerve
4. Ureter attached to peritoneum
5. Superior vesical artery

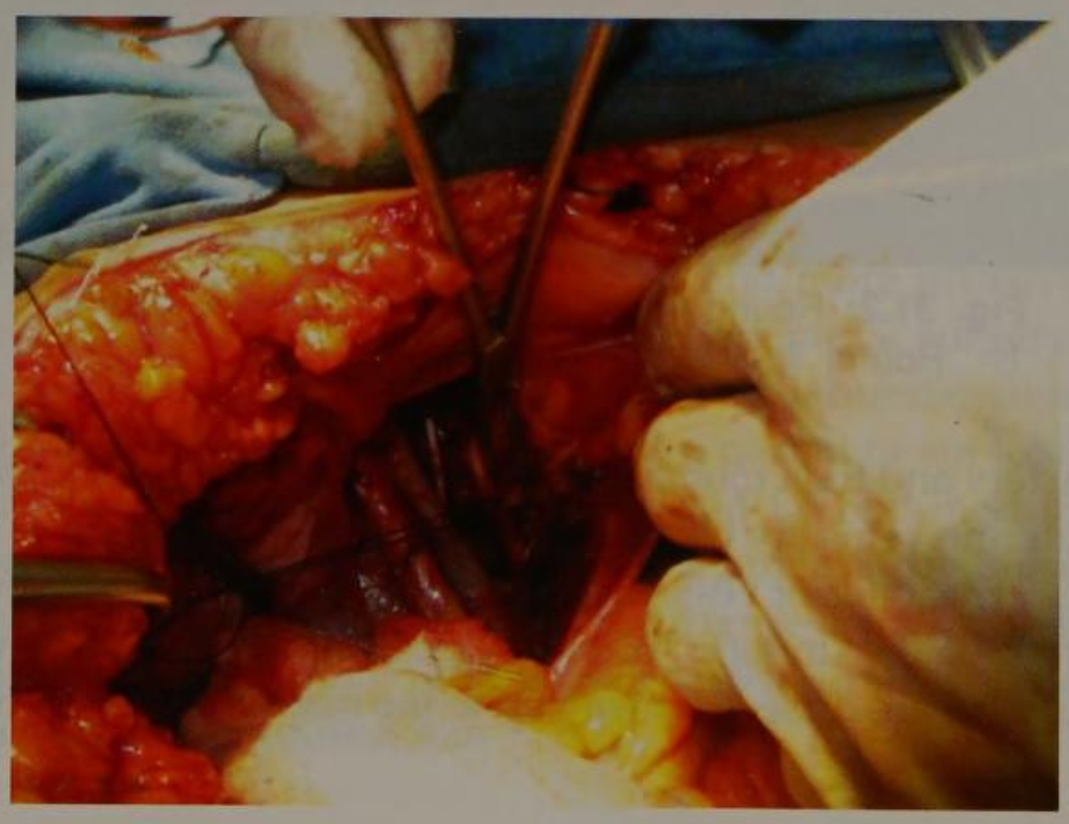

Fig. 31.7: Ligation of uterine artery
1. Internal iliac artery
2. Uterine artery ligated at origin

Fig. 31.8: Pararectal space is shown from posterior aspect

Fig. 31.9: Pouch of Douglas space is opened and rectum is dissected down
1. Uterus
2. Posterior vagina

oncological advantage gained by dissecting ureters off their peritoneal attachments. In postradiotherapy patients every effort should be made to keep the lateral mesentry of the pelvic ureter. Great care must be taken in handling the ureteric adventitia to avoid severing the blood supply to the ureters.

Posteriorly, the peritoneum over the pouch of Douglas is incised and the rectovaginal space developed by applying smooth traction on the rectum (Fig. 31.9). This allows dissection and division of the uterosacral ligaments mid-way from the sacrum, which frees the uterus from its posterior attachment in the pelvis. To release the uterus from its lateral pelvic attachment, the cardinal ligaments are clamped and divided at the level of the pelvic sidewall, all the way across the paravaginal tissues down to the vagina. The vesicovaginal (anterior), rectovaginal (posterior) spaces are further deepened, and the bladder and rectal pillars are transected at their attachments to the bladder and rectum, respectively (as opposed to their vaginal attachments in simple vaginectomy). The ureters should be dissected away before resection of the vagina with the cardinal and vesicouterine ligaments.

Bladder and rectal pillars are resected down to the pelvic floor. The vagina is entered anteriorly and transected at the desired level using a knife or scissors. The vault is closed, and the vaginal angles are sutured to the paravaginal tissues. The pelvic peritoneum is not closed, and drains are used only if doubt exists regarding the adequacy of hemostasis.

In total vaginectomy, vaginal incision is placed 1-2 cm above the hymenal ring (Fig. 31.10). Subvaginal infiltration with saline (or mixed with adrenaline in suitable patients) facilitates dissection and reduces bleeding (Figs 31.11 and 31.12). A relaxing incision unilaterally or bilaterally (similar to episiotomy) gives good access. Extreme caution has to be taken especially in middle vagina to avoid injury to rectum. For beginners it is often helpful to place a finger in the rectum which eases the dissection in subvaginal plane and avoids entering into the tumor and rectum. Pouch of Douglas is

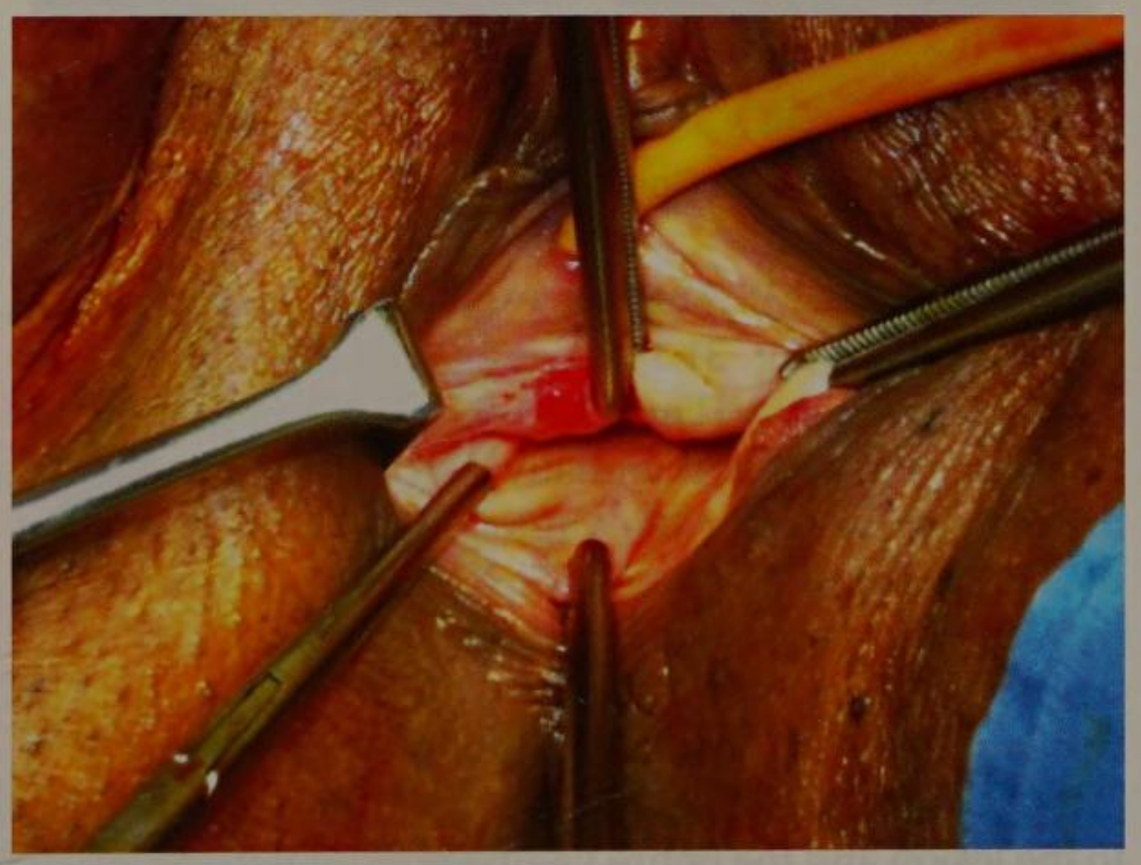

Fig. 31.10: Starting vaginal dissection of total vaginectomy. This is a case of post- radiotherapy residual carcinoma of cervix. 12,3,6, and 9 o'clock positions are held with Kocher's forceps1-2 cm inside the introitus

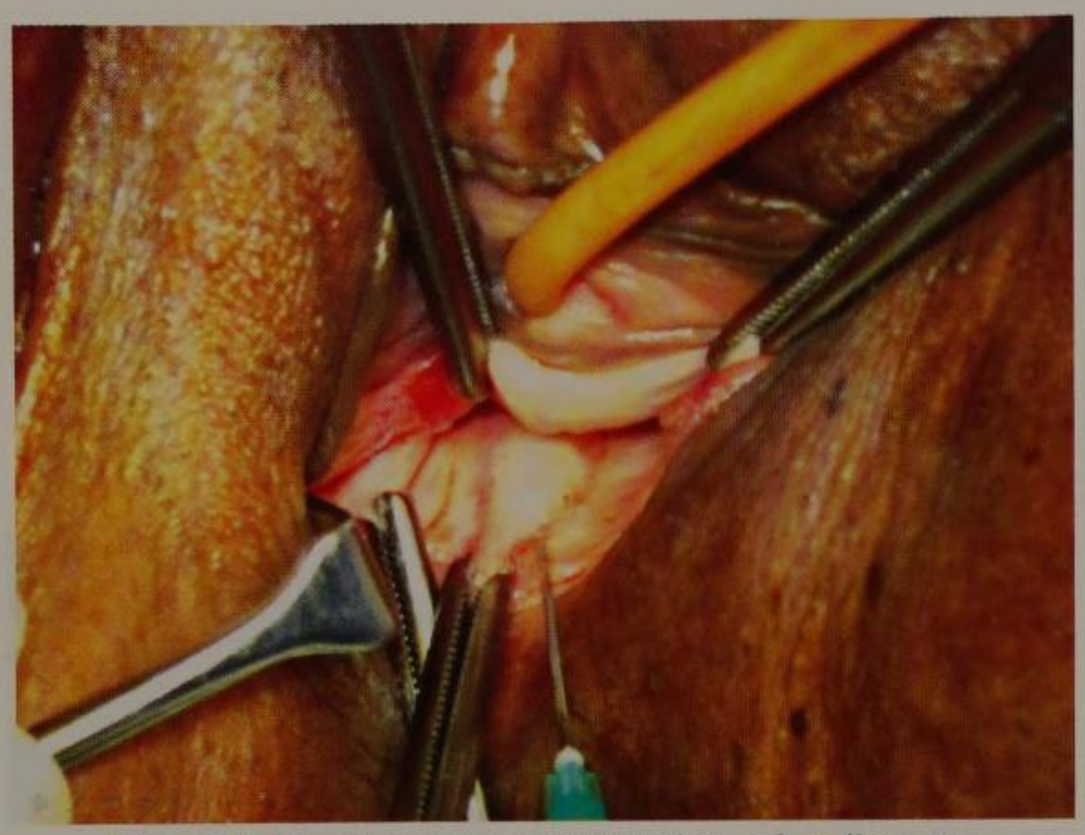

Fig. 31.11: Subvaginal infiltration of saline to ease the dissection

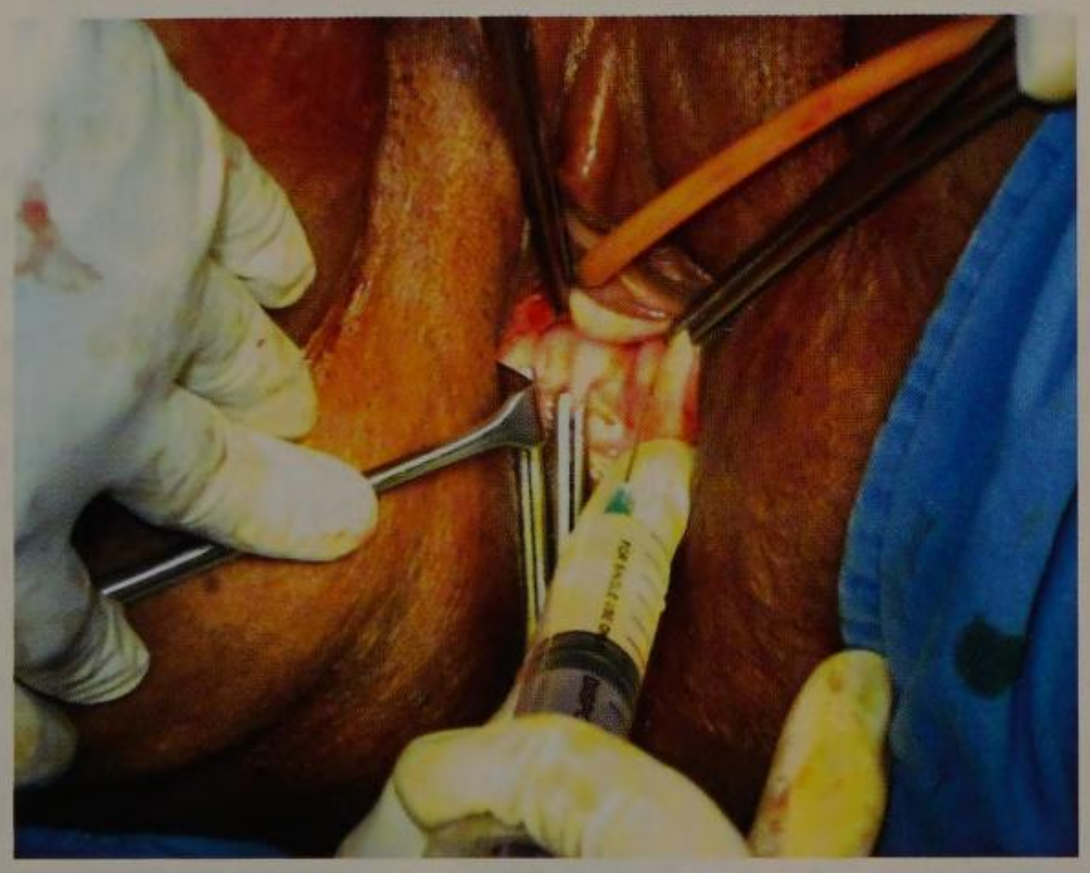

Fig. 31.12: Continuing saline injection

entered (Fig. 31.13). Anterior vaginal wall is dissected in a similar way (Fig. 31.14). Vagina and vaginal cuff are sutured from below (Figs 31.15 and 31.16). Specimen can be removed either abdominally (Fig. 31.17) or vaginally, depends on whether the vaginal dissection is done at the beginning or at the end (Figs 31.18 to 31.20).

Vaginectomy may be partial, subtotal, or total, depending on the extent of the disease, how well circumscribed the lesion is, and whether it is multifocal. The excision should include 2 cm of normal vagina distal to the lesion and the entire vagina proximal to the lesion. If more than a third of the upper vagina is removed, then vaginal reconstruction using a split-thickness skin graft is required in order to have normal sexual function.

Simple vaginectomy is indicated when invasion is suspected in a patient with VAIN. The approach usually

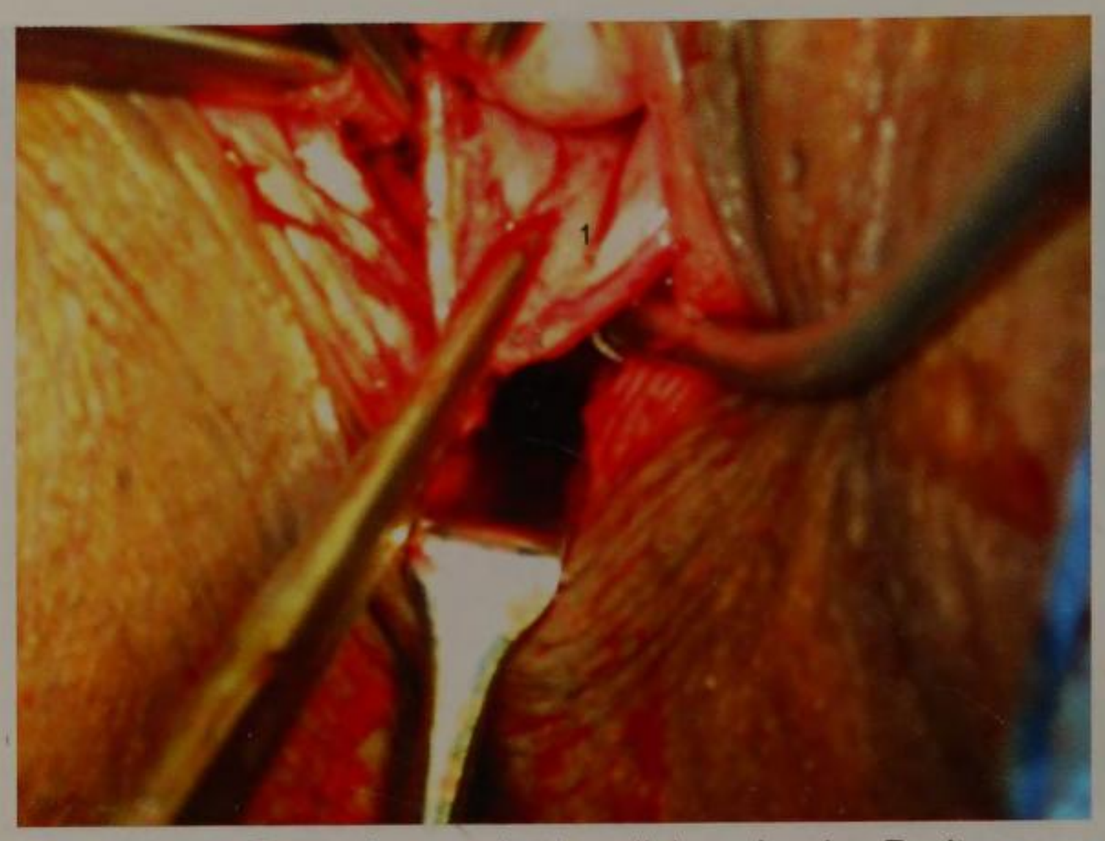

Fig. 31.13: Posterior vaginal wall is raised. Peritoneum of the pouch of Douglas is opened.
1. Raised posterior vagina

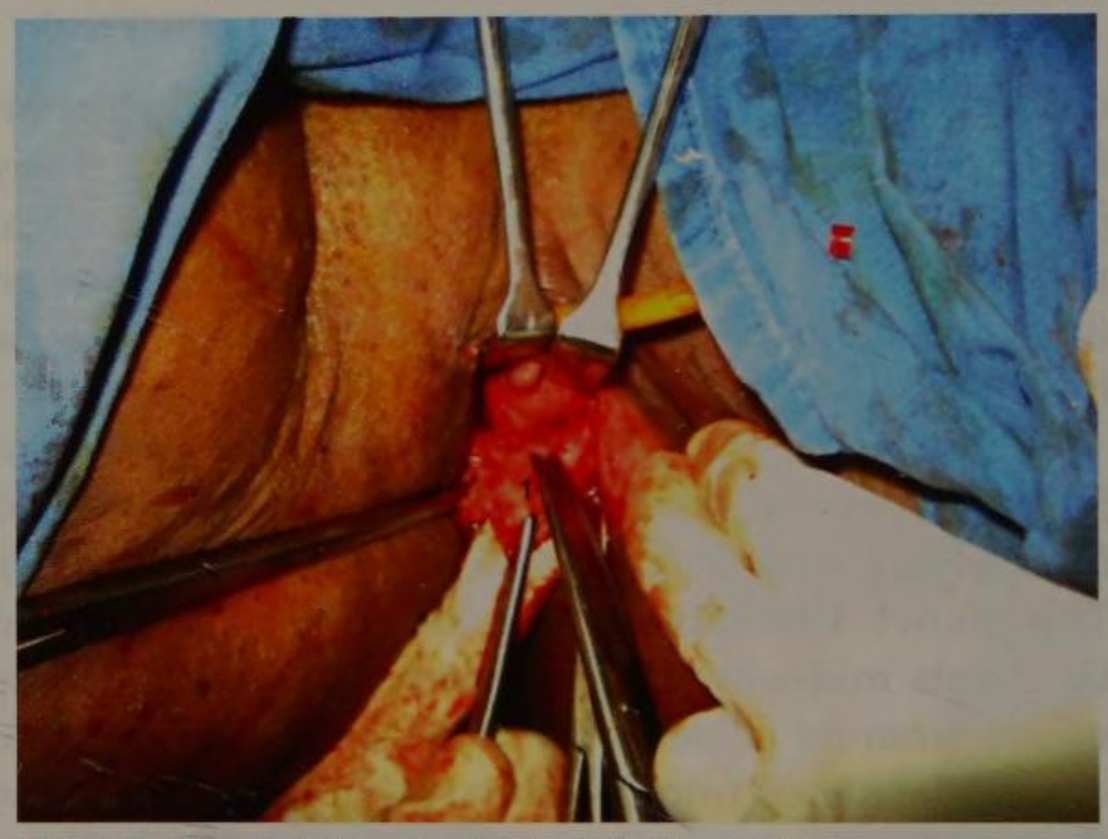

Fig. 31.14: Anterior vaginal wall dissection
1. Anterior vaginal wall.

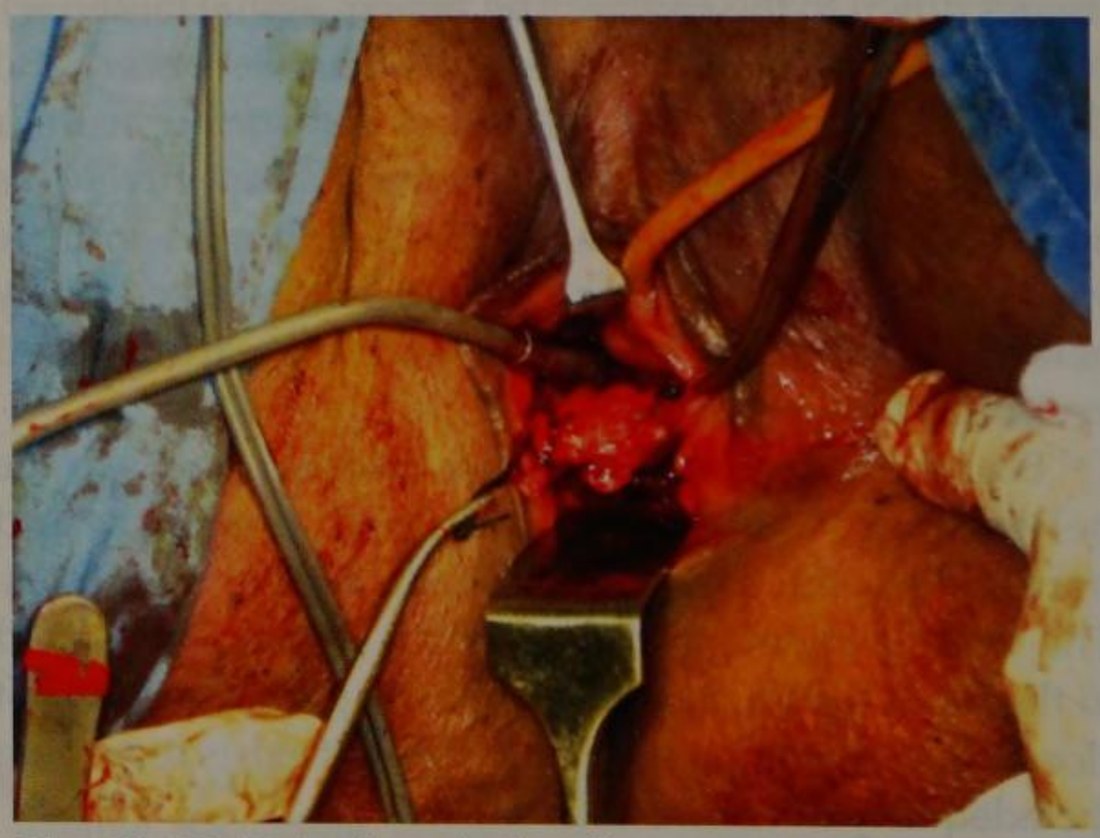

Fig. 31.15: Raised vaginal walls are sutured together to prevent abdominal spill of tumor

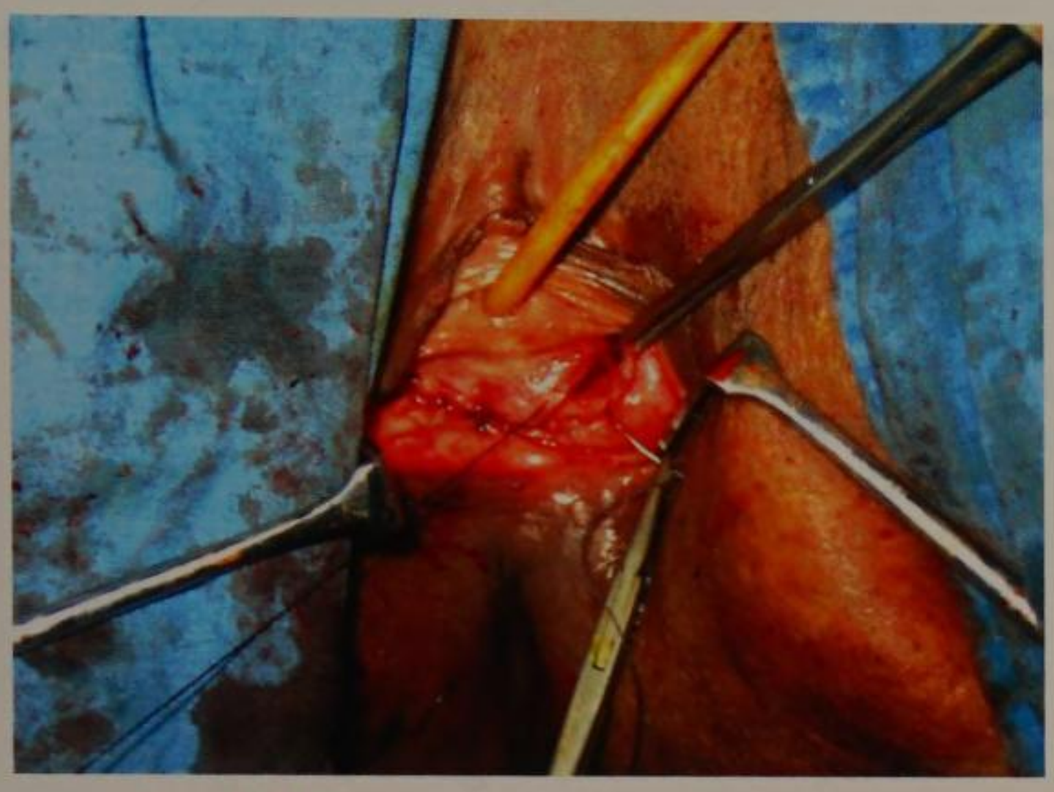

Fig. 31.16: Vagina is sutured from below

Fig. 31.18: Removed total hysterectomy and total vaginectomy specimen
1. Uterus 2. Cervix 3. Vagina

Fig. 31.17: Per-abdominal view of the dissection
1. Incised vesico-uterine peritoneum
2. Uterus
3. Vagina
4. Suture in the lower vagina
5. Divided and suture round ligament
6. Ligated medial end of uterine artery

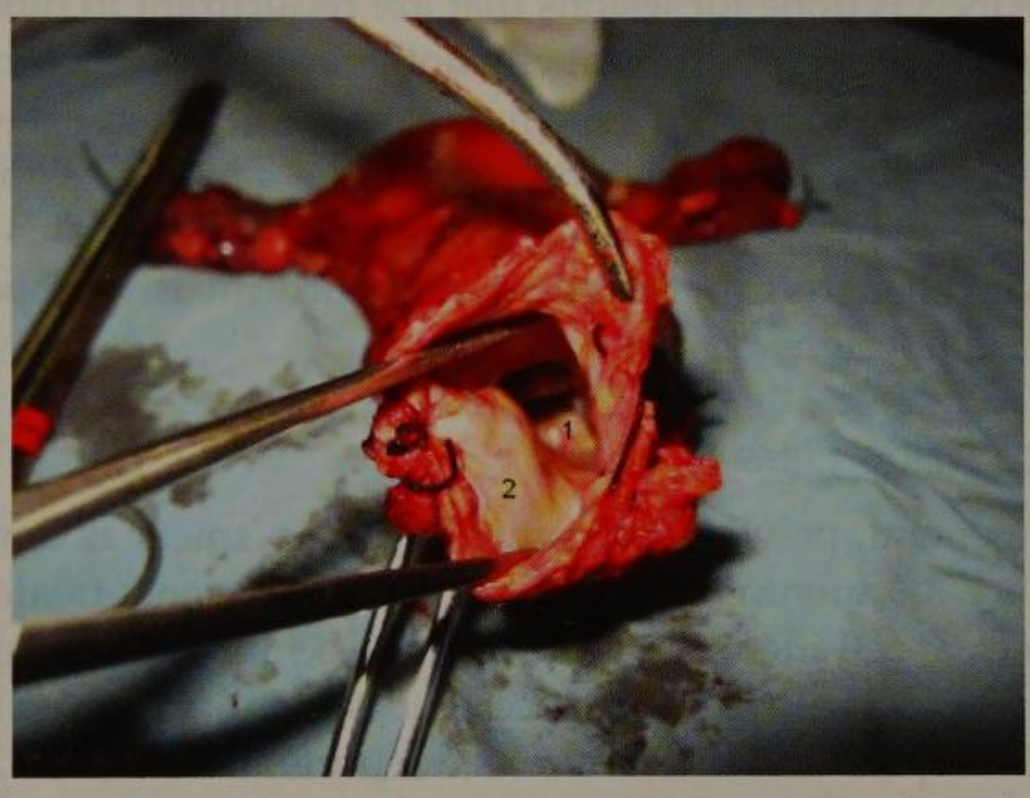

Fig. 31.19: Specimen showing cervical tumor through the vagina
1. Growth of the cervix
2. Vaginal wall

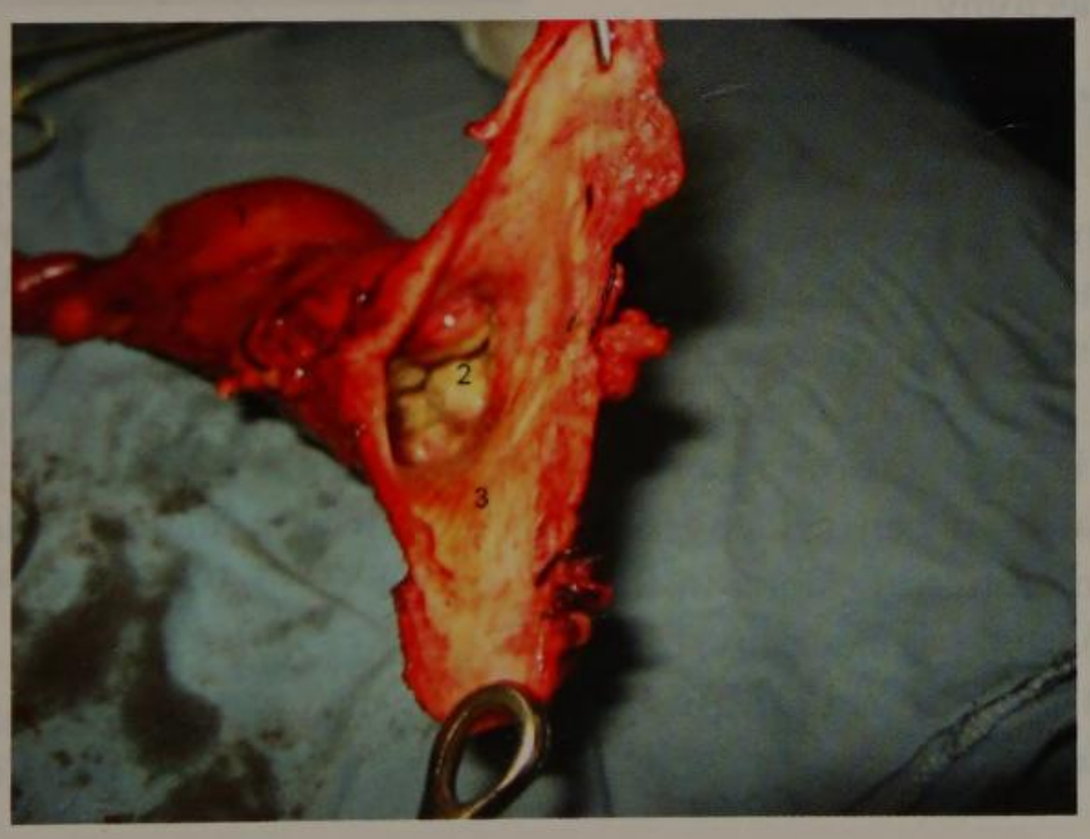

Fig. 31.20: Right lateral part is cut to expose the cervical growth
1. Uterus
2. Cervical growth
3. Vagina

is vaginal. In postmenopausal women with poorly estrogenized vaginal mucosa, estrogen cream can be used 2-4 weeks prior to the operation. Lugol solution is used to delineate the abnormal mucosa. Injecting saline solution into the submucosa elevates the lesion from the underlying tissue layer and helps in the excision. Usually, a 3 to 5 mm margin of healthy mucosa is adequate. For lesions located in the upper vagina, sutures are placed in the apex to place traction and the upper vagina is excised. The bladder and rectal pillars (lymph vascular pillars) are transected from their vaginal attachments. Blunt dissection is used to further remove the specimen. The surgeon must keep in mind the proximity of the ureters to the corners of the apex. The vagina is closed with interrupted biodegradable sutures.

In young and nulliparous patients vaginectomy for VAIN 3 is done for lesions that are recalcitrant to other forms of therapy (topical chemotherapy, laser surgery, electrocautery, etc.) or when invasion is suspected. Conservative vaginectomy is done as far as possible where a wide local excision is most appropriate.[9] This is an excellent form of treatment small early invasive upper vaginal lesions.[10]

Follow-up Care

In general, pelvic examination and Pap smear is done every 3-6 months for the first-5 years. Patients treated for clear cell adenocarcinoma need to be monitored long-term because late recurrences and second primaries in DES-exposed women have been reported to occur 17-20 years after the initial treatment.

Vaginal cancer screening is not cost effective. However, an inspection of vagina in cervical cancer screening programme can pick up early lesions, which improves the outcome of vaginectomy.

CONCLUSIONS

The indications of vaginectomy are pre-invasive and early invasive carcinomas of the vagina. Because of the rarity of vaginal cancers consensus regarding management is still lacking. In clinical practice the commonest indication of vaginectomy is a carcinoma cervix extending onto the vagina and in central vaginal recurrences together with exenteration. Lesions in the lower vagina are managed by partial vaginectomy, total or partial vulvectomy and bilateral inguinal lymphadenectomy. Stage I lesions in the upper vagina are treated by radical hysterectomy, subtotal vaginectomy and pelvic lymphadenectomy.

Key Points

1. When uterus is *in situ*, radical vaginectomy can be approached vaginally or abdominally.
2. If 2/3rds of vagina needs to be removed, a combined approach is required to mobilize vagina.
3. In patients with previous hysterectomy abdominal or combined approach is needed to prevent injury to ureters.
4. Oncologically, combining radical vaginectomy with radical hysterectomy, makes it technically more feasible and obtains a wider clearance for vaginal lesion.
5. Technique of vaginectomy with step-by-step illustrations is described.
6. Vaginectomy may be partial, subtotal or total depending on extent of disease.
7. If more than a third of upper vagina is removed, vaginal reconstruction with split-thickness graft is required for normal sexual function.
8. Simple vaginectomy can be done in patients with VAIN, the approach is usually vaginal.
9. Submucosal injection of saline elevates lesion from underlying tissues and helps excision.
10. Follow-up is generally five years for squamous cell carcinoma, but in cases of clear cell adenocarcinomas long term follow-up is essential as recurrences have occured 17-20 years after initial treatment.

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32

Colpocleisis

Neerja Goel, Seema Ummat

INTRODUCTION

The development of pelvic organ prolapse is a common problem. An estimated 11% of women will undergo surgery for symptomatic prolapse or urinary incontinence in their lifetime.[1] Moreover, a recent study has shown that 29% of women undergoing surgery will require reoperation. Prolapse is more often seen in aging population, many of whom have other significant underlying medical problems, often making them poor surgical candidates. Also, some women become sexually less active with age due to loss of sexual partners or to personal or partner's medical disorders. Given the high rate of failure with reconstructive surgery for prolapse these patients may be willing to compromise vaginal function in exchange for a more definitive surgical correction of the problem.

The only non-surgical option consists of fitting the patient with a vaginal pessary. Some of these patients are unable to retain a pessary due to a very wide genital hiatus. Moreover, retaining a pessary for a long time can cause vaginal ulcerations. Obliteration of the vagina via complete or partial colpocleisis is an attractive alternative for these patients.

Partial colpocleisis was first performed by Neugebauer in 1867, who later published his experience in 1881.[2] Le Fort also published his results for partial colpocleisis in 1877.[3] Since that time, various other modifications have also been proposed for closure of the vagina.

Evaluation

The physician must assess the patient's overall general fitness and desire for sexual activity. It is important to ascertain whether a patient's potential and desire for sexual activity could change in the future. In addition, physical examination should assess the extent of prolapse in the anterior, apical and posterior vaginal compartments. An assessment of continence, either in the form of urodynamics or a cough stress test with a full bladder, should be performed with reduction of the prolapse. After the patient has voided, a post-void residual measurement should also be measured. If uterus is present and partial colpocleisis is proposed, an endometrial biopsy is advised to help rule out any intrauterine pathology that may contraindicate leaving the uterus in situ. Any ulcerations in the vaginal mucosa should be treated with topical estrogen and healed prior to surgery.

Once the prolapse has protruded beyond the hymen, patients develop difficulties due to obstructive voiding, leading to urinary retention and recurrent urinary tract infections. This may occur likely due to obstruction or kinking of the urethra. Long standing voiding difficulties may lead to detrusor underactivity or overactivity. So preoperative urodynamic testing is important to establish preoperative bladder function and may help to predict postoperative bladder emptying and symptomatology. Rosenzweig et al[4] performed urodynamic testing in women with severe prolapse and found that while none of the subjects complained incontinence more often than once a week, 59% were found to have occult urinary incontinence when the prolapse was reduced by a ring pessary and 41% were found to have unstable detrusor contractions demonstrated during urodynamic testing. Therefore, preoperative assessment of bladder function is important to counsel the patient with regards to expectations for postoperative bladder function.

Anesthesia

Complete or partial colpocleisis may be performed under any type of anesthesia, including local anesthesia with sedation[5,6] and pudendal nerve block. The selection of appropriate anesthesia should be based on the anticipated length of surgery and the patient's history.

Partial Colpocleisis

The most common method for performing partial colpocleisis is the technique described by Le Fort or its variations.

Steps

1. A tenaculum or vulsellum is placed on the anterior lip of the cervix and the anterior wall is exposed. A rectangle is demarcated on the mucosa with the back portion of a scalpel or with dye. This extends from 1 cm below the urethral meatus to about 1.5 cm from the cervical os. The demarcated mucosa-and only the mucosa is denuded by means of sharp dissection (Fig. 32.1).
2. The cervix is regrasped on its posterior lip and pulled forcefully upward and a corresponding rectangle of mucosa is similarly removed. As in the anterior denudation, the underlying, more condensed tissue is left (Fig. 32.2).

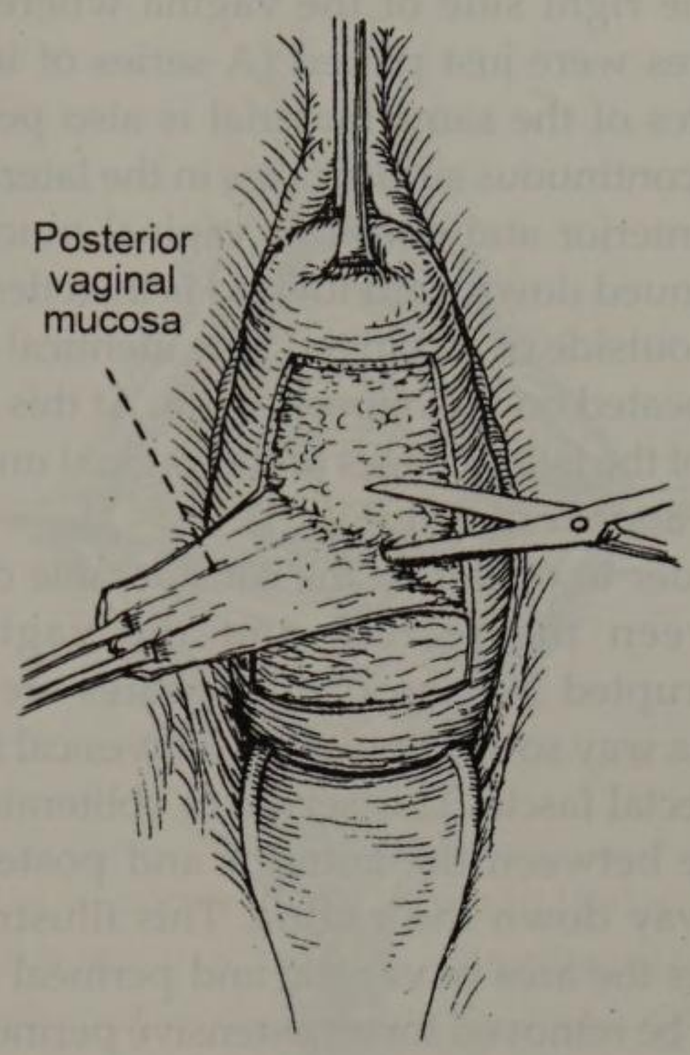

Fig. 32.2: Posterior vaginal mucosa is excised

3. Three or four 2-0 absorbable sutures are placed in the vaginal mucosa near the external cervical os. They are tied after the vulsellum is removed (Fig. 32.3).
4. Allis' clamps are placed on the two anterior and two posterior corners of the vaginal mucosa. Then, a continuous 2-0 absorbable suture is started high

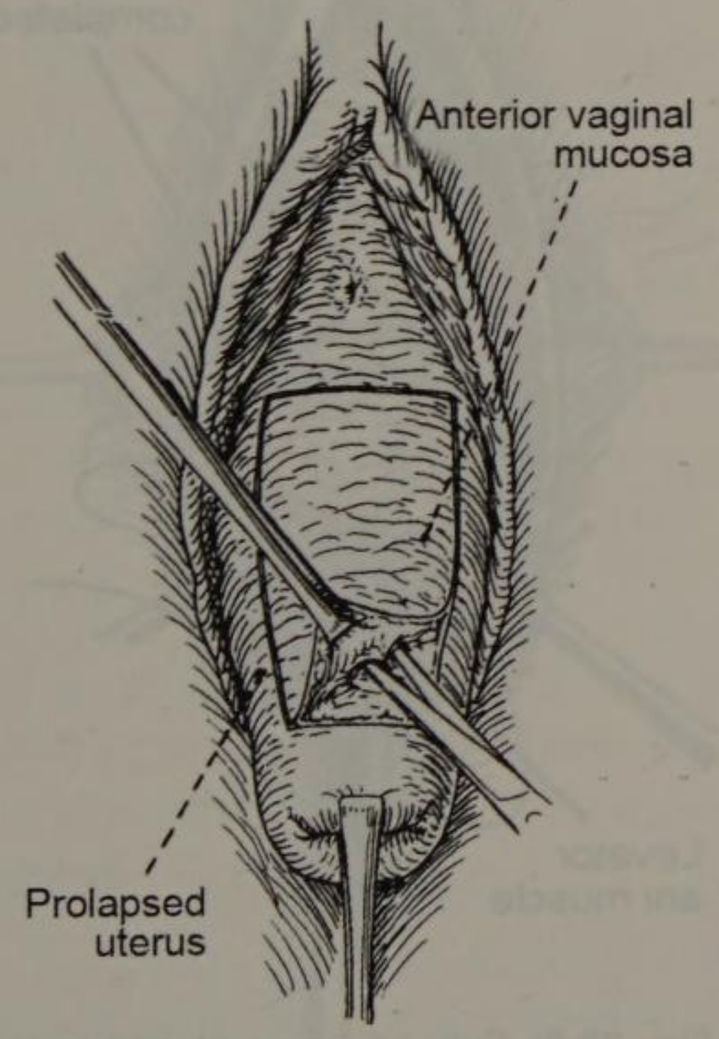

Fig. 32.1: Demarcated anterior vaginal mucosa is being denuded by sharp dissection

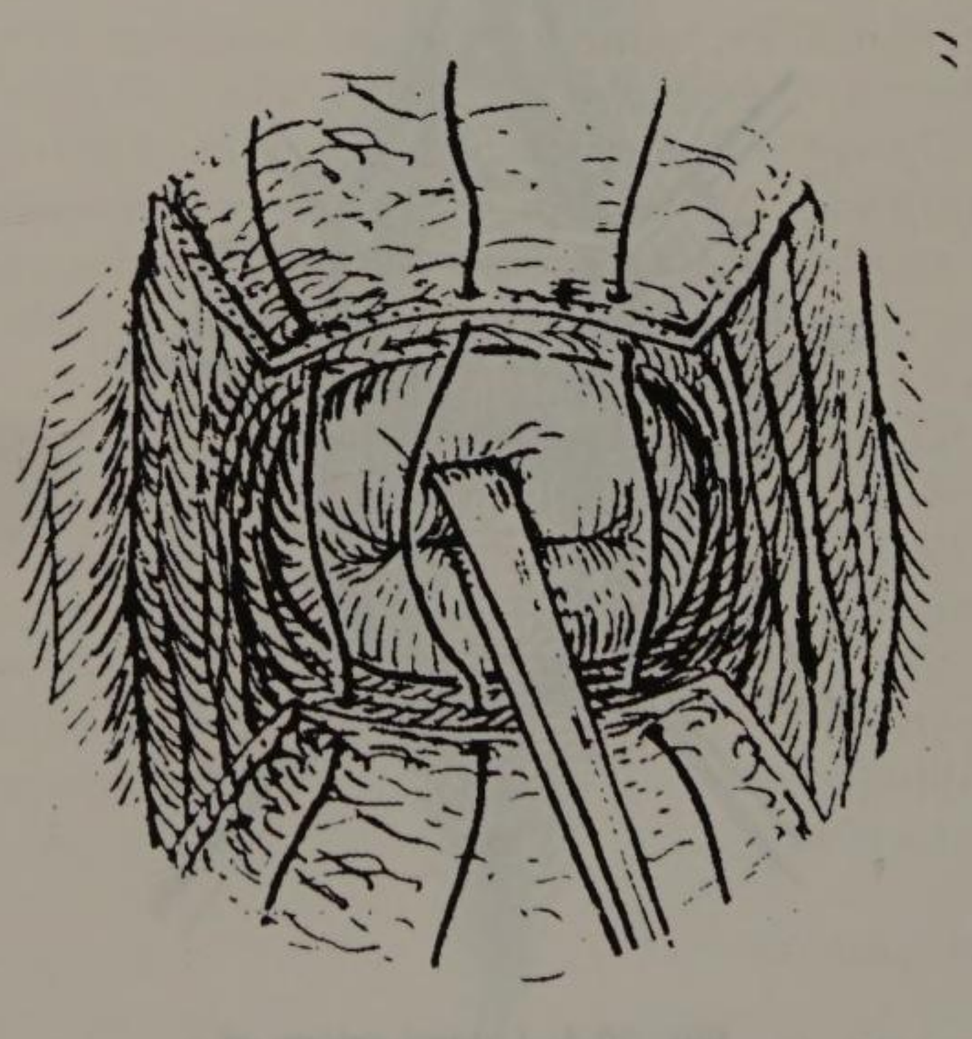

Fig. 32.3: 3 sutures are placed in vaginal mucosa near the os

on the right side of the vagina where the three sutures were just placed (A series of interrupted sutures of the same material is also permissible). This continuous suture takes in the lateral edges of the anterior and posterior vaginal mucosa and is continued downward toward is then tied (with the knot outside of rectangle). The identical procedure is repeated on the opposite side. At this point only half of the lateral edges of the vaginal mucosa have been approximated (Fig. 32.4).

5. In order to obliterate the considerable dead space between the rectum and the vagina, three interrupted 3-0 absorbable sutures are placed in such a way so as to unite the subvesical fascia with the rectal fascia. This serves to obliterate the dead space between the anterior and posterior walls halfway down the vagina. This illustration also shows the area of vaginal and perineal tissue that must be removed for an extensive perineorrhaphy. This tissue is incised with a scalpel; and then dissected free with a scissors (Fig. 32.5).
6. Allis' clamps or tenacula are positioned on the vaginal mucosa and the skin of the perineal body and the tissues pulled apart. Two interrupted 0 absorbable sutures are placed in the levator ani muscles and fascia (Fig. 32.6).

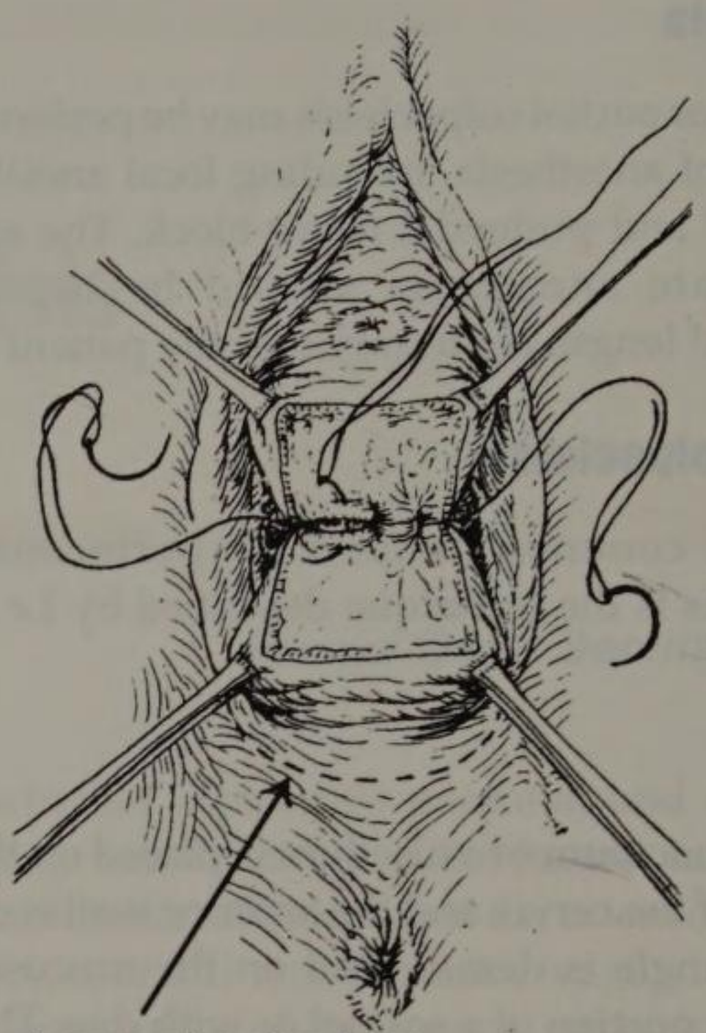

Fig. 32.5: 3 sutures are placed to obliterate dead space between rectum and vagina

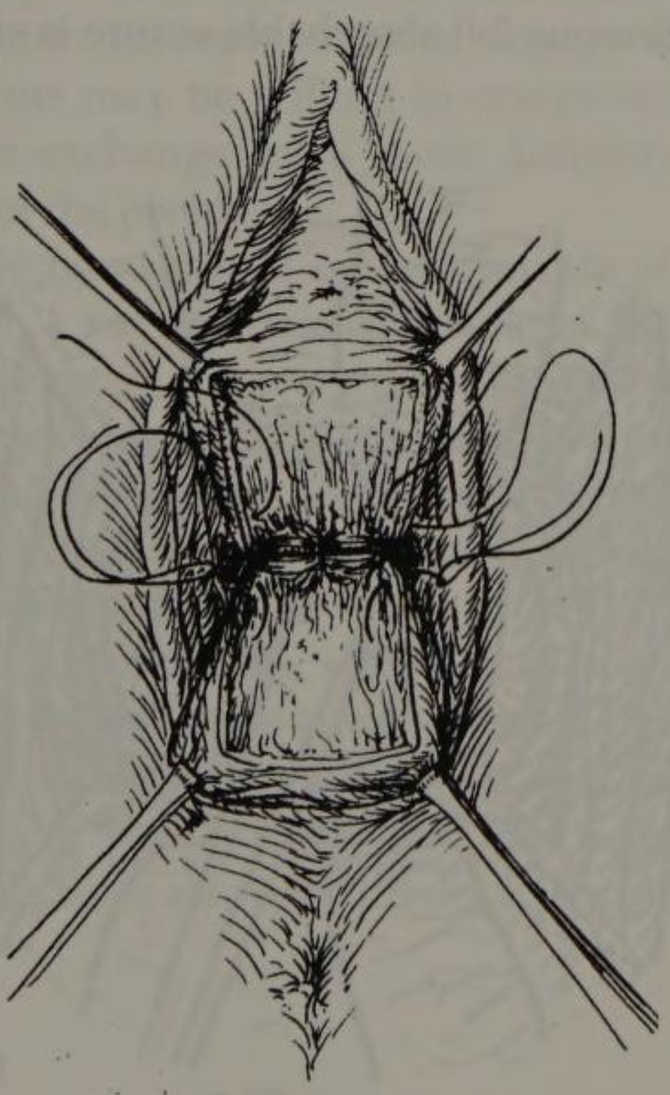

Fig. 32.4: Lateral edges of vagina being approximated

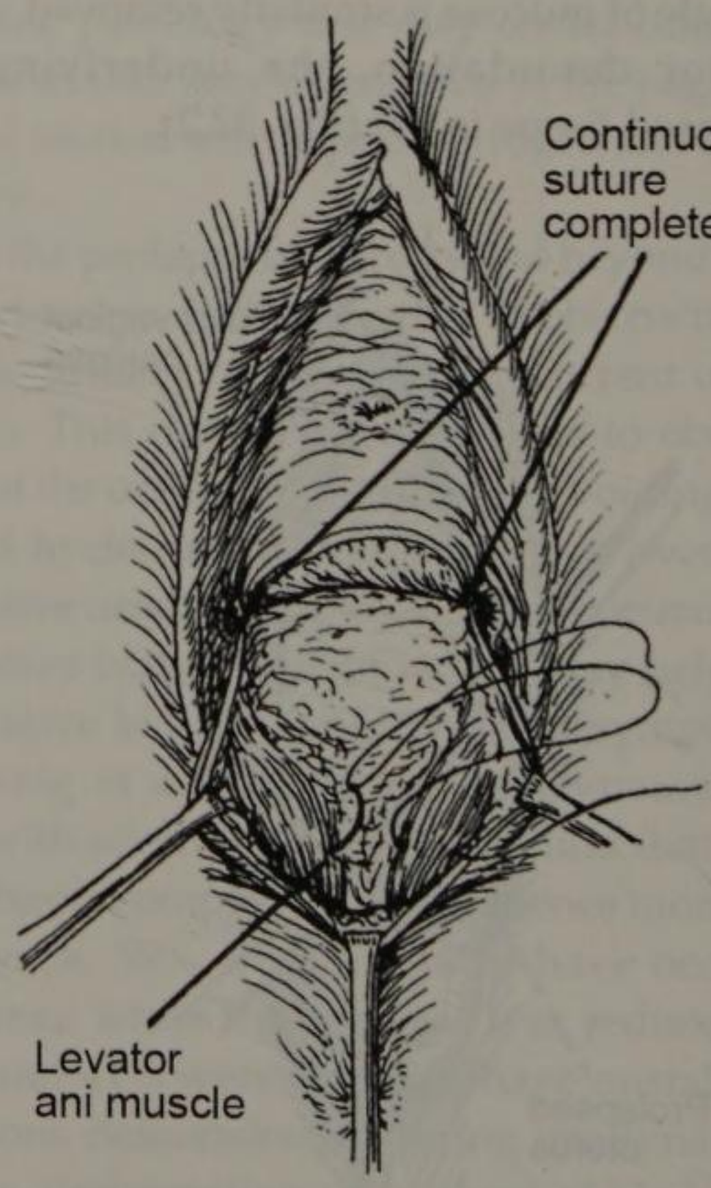

Fig. 32.6: Sutures being placed in the levator ani muscles

7. The lateral Allis' clamps on the vaginal mucosa are removed and the two sutures on the levator ani muscles are tied. Following this, Allis' clamps are placed on the labia minora, for traction. A continuous 2-0 absorbable suture is begun where the first continuous suture on the left side was tied (or where the last interrupted suture had been placed) - that is, halfway along the denuded rectangles. The suturing is continued upto the vaginal introitus, where it is tied. The same procedure is repeated on the opposite side. This completes the approximation of the denuded rectangles on the anterior and posterior walls of the vagina, leaving two tunnels of mucosa on either side (Fig. 32.7).
8. Once the second set of sutures has been tied at the outlet, the remaining portions of the anterior and posterior edges of the vagina are brought together by means of 2-0 absorbable sutures. Care must be taken not to pull the anterior vaginal mucosa too far down in order not to abnormally deflect the urinary stream (Fig. 32.8).
9. The two tunnels at either side constitute the only remaining vaginal spaces with the exception of their cross-communication near the cervix (Fig. 32.9).

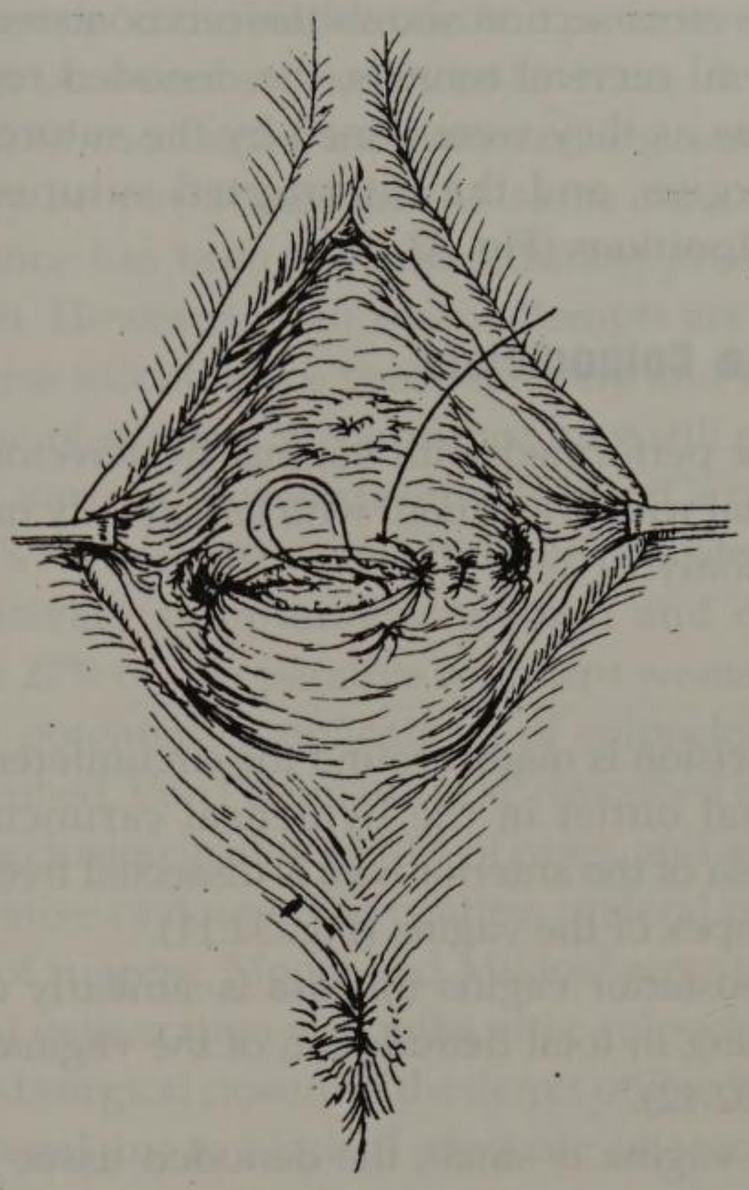

Fig. 32.8: Anterior and posterior edge of vagina being brought together

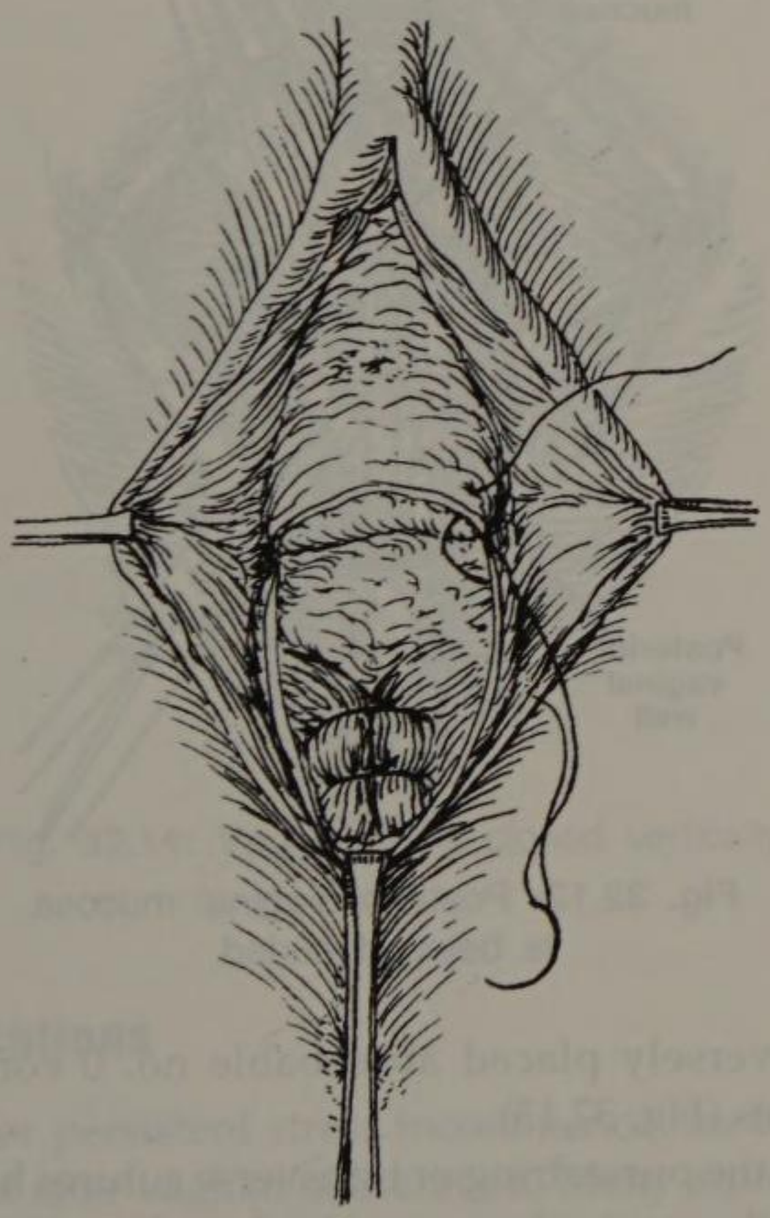

Fig. 32.7: Denuded rectangles of vagina being approximated starting from lateral angle

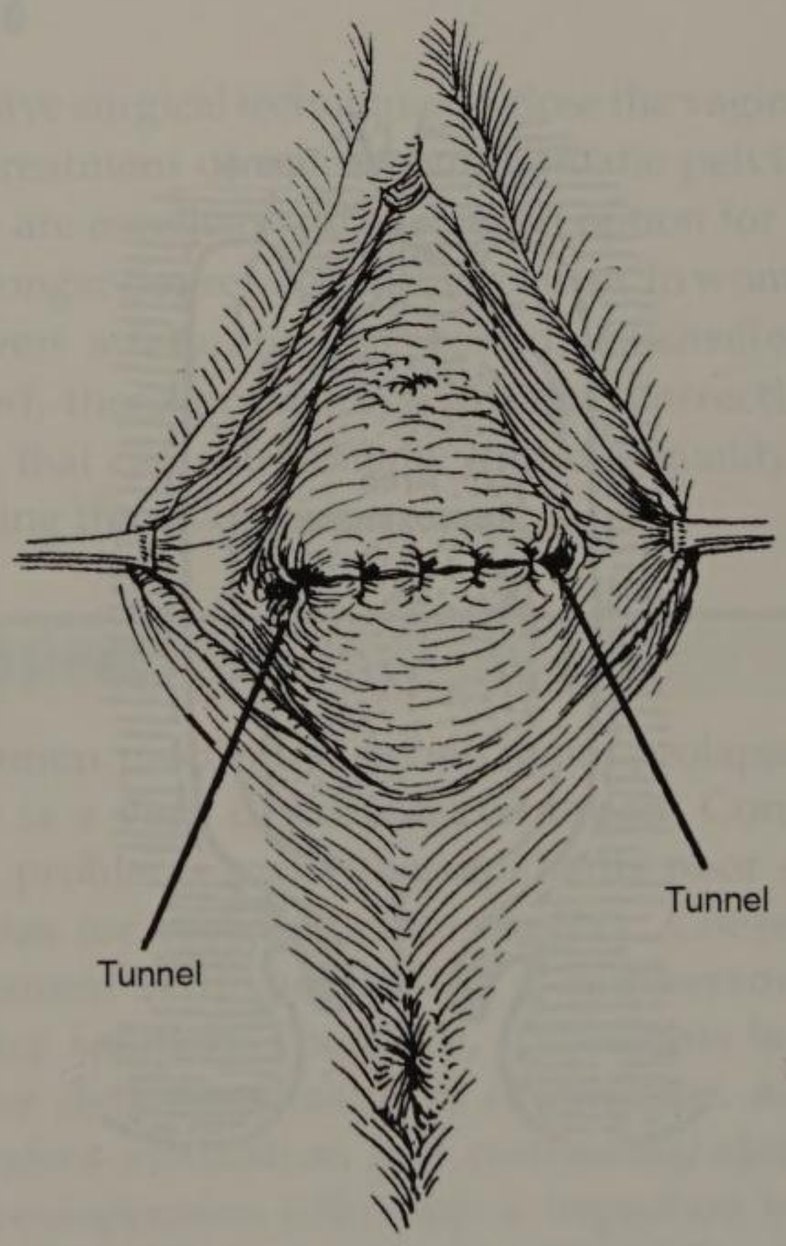

Fig. 32.9: Two tunnels on either side of the remaining vaginal spaces

10. The cross-section shows the cervix above, the two lateral cervical tunnels, the denuded rectangular areas as they were joined by the sutures at their margins, and the interrupted sutures in their midportions (Fig. 32.10).

Complete Colpocleisis

It may be performed with vaginal hysterectomy or on the vaginal wall in a patient who has already undergone hysterectomy.

Steps

1. An incision is made around the circumference of the vaginal outlet in the hymeneal carunculae. The mucosa of the anterior wall is dissected free upto the very apex of the vagina (Fig. 32.11).
2. The posterior vagina mucosa is similarly denuded, resulting in total denudation of the vaginal mucosa (Fig. 32.12).
3. If the vagina is small, the denuded tissue is closed with successive absorbable 0 purse string sutures placed from above, downwards. Here, the second pursestring suture is being placed. If the vagina is large, it is closed with two or more rows of transversely placed absorbable no. 0 continuous sutures (Fig. 32.13).
4. After the pursestring or transverse sutures have been tied, the vaginal mucosa is closed vertically with interrupted 2-0 absorbable sutures (Fig. 32.14).

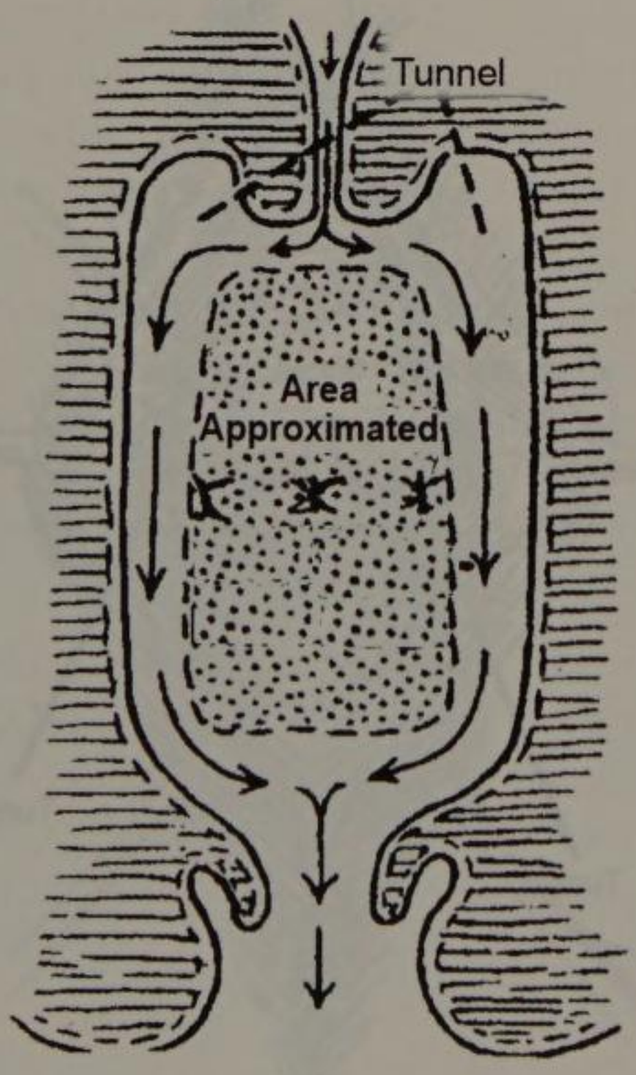

Fig. 32.10: Diagrammatic presentation of the crosssection at the end of surgery

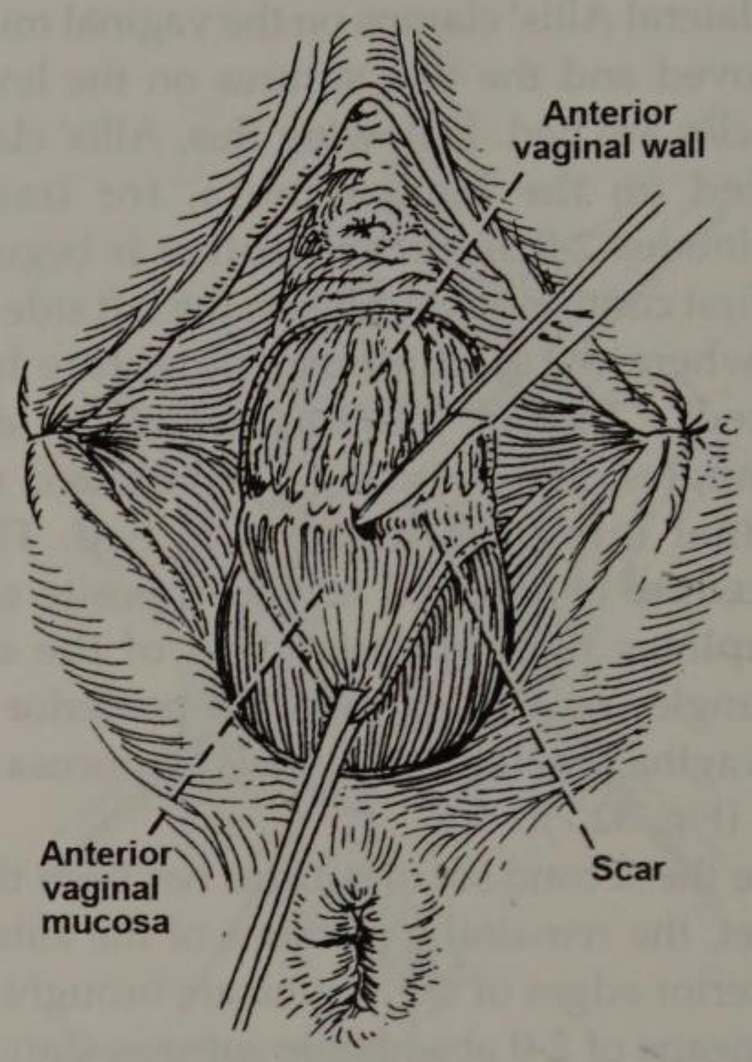

Fig. 32.11: Circular incision at the vaginal outlet. Anterior wall of vagina is dissected

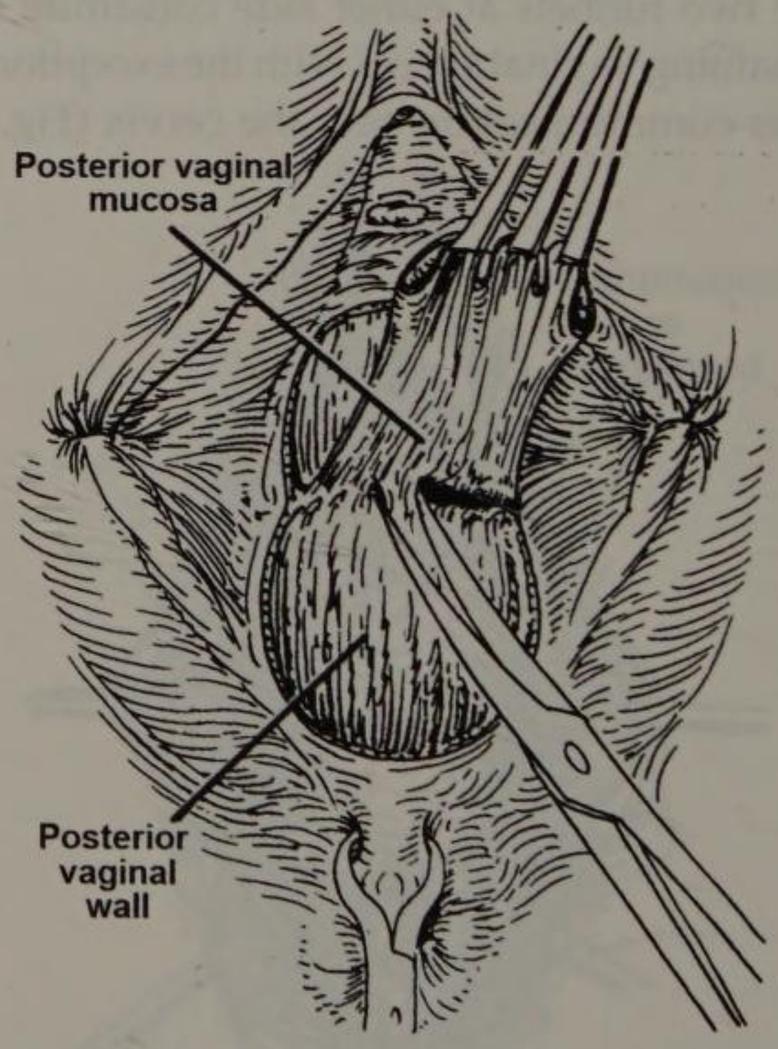

Fig. 32.12: Posterior vaginal mucosa is being denuded

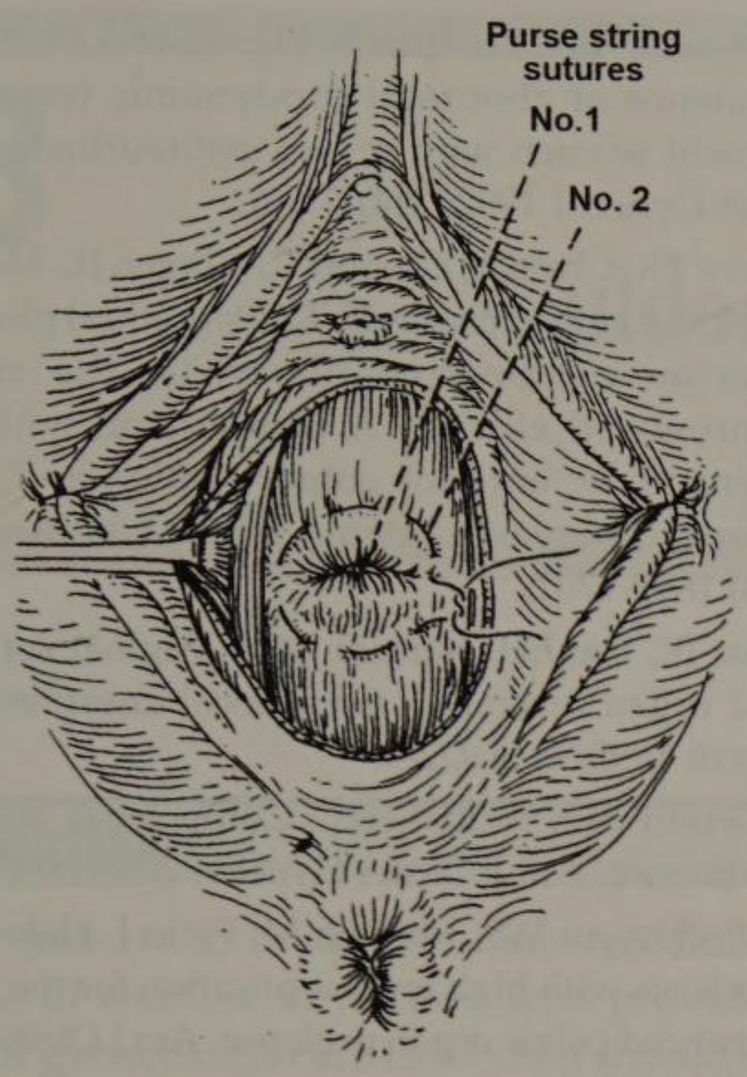

Fig. 32.13: Purse string sutures are being placed

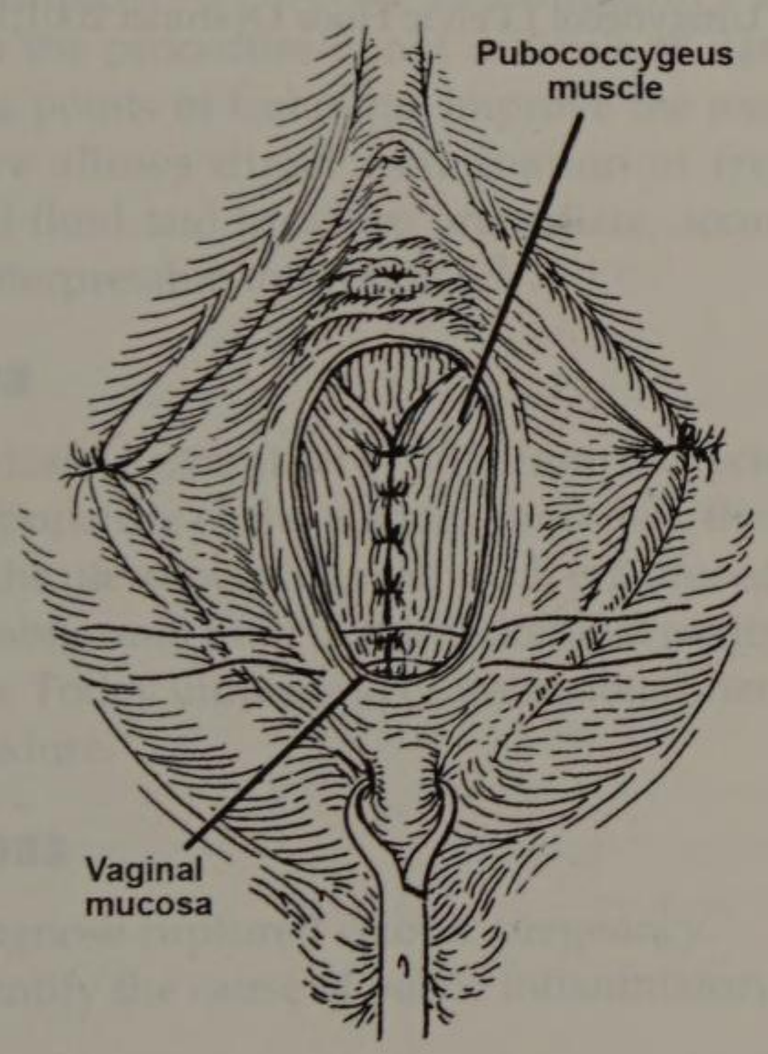

Fig. 32.14: Vagina being closed vertically

Complications

De novo or persistent stress incontinence has been well described after vaginal obliteration. Many authors have advocated suburethral plication of pubocervical fascia to further support the bladder neck in patients who have no occult or overt stress incontinence. A specific procedure to treat stress incontinence, e.g. suburethral sling may be performed at the same time if stress incontinence has been identified during preoperative evaluation. However, even when attempts are made to detect stress incontinence preoperatively and corrected at the time of surgery, incontinence may still persist or occur *de novo* postoperatively. In FitzGerakd and Brubaker's review[7] stress incontinence persisted in 28% preoperatively symptomatic women and occurred *de novo* in 27% of preoperative continent women.

Other potential complications of colpocleisis have been described. Von Pechmann et al[8] described reversible ureteral occlusion in almost 10% of cases, and advocated intraoperative cystoscopy to confirm ureteral patency at the time of surgery. Moore and Miklos[9] reported a case of vaginal evisceration 6 months after colpocleisis, and performed surgical closure of the defect utilized allogenic graft material due to a lack of adequate adjacent vaginal tissues. This latter complication attests to the need for continued postoperative follow-up of patients to ensure a lasting repair.

Outcome

Obliterative surgical techniques to close the vaginal vault for the treatment of severe symptomatic pelvic organ prolapse are excellent and successful option for women who no longer desire vaginal intercourse. In women who have been adequately screened, counseled, and evaluated, these procedures promise correction of a problem that can substantially improve quality of life, minimizing the risk of recurrence.

CONCLUSIONS

The common problem of pelvic organ prolapse in old patients is a very distressing situation. Concurrent medical problems make these patients poor surgical candidates for reconstructive surgery. Conservative management with pessary is a cumbersome and temporary solution. Therefore, colpocleisis is a good option for definitive treatment of prolapse. Adequate preoperative evaluation and counseling along with proper postoperative follow-up is important to derive maximum benefit and satisfaction from the procedure.

Key Points

1. Pelvic organ prolapse is a common problem in old age.
2. Reconstructive surgery and pessaries are inappropriate methods of treatment.
3. Colpocleisis is a preferable alternative.
4. Persistent or *de novo* incontinence is the most common complication.
5. Thorough preoperative evaluation counseling and postoperative follow-up are important.

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33

Culdocentesis and Colpotomy

Shalini Jain

INTRODUCTION

Culdocentesis is a technique to obtain free fluid from the cul-de-sac of women. Physicians who provide comprehensive or gynecologic care to women should be capable of doing this procedure. The main indications are suspected ruptured ectopic pregnancy and suspected acute salpingitis or pelvic inflammatory disease. Although the procedure is not difficult or dangerous, many fine points of technique improve the result. This procedure allows direct examination of free intraperitoneal fluid and provides immediate, accurate and readily interpretable information.[1]

Definition

Culdocentesis is aspiration of fluid from the rectouterine space by puncture of the vaginal vault near the midline between the uterosacral ligaments.[2] It is a procedure that looks for abnormal fluid in the abdominal cavity behind the uterus. Today ultrasound examinations often replace this procedure.

Indications

1. To diagnose ruptured ectopic pregnancy.
2. To identify the cause of pelvic inflammatory disease (PID).
3. Rarely it has also been used for outpatient treatment of Ovarian Hyperstimulation Syndrome (OHSS) with ascites along with intravenous albumin administration.[3]

Materials Required

A Sim's speculum, a tenaculum, an 18-gauge spinal needle, a 10 ml syringe, sterile sponge and sterile gloves (Fig. 33.1)

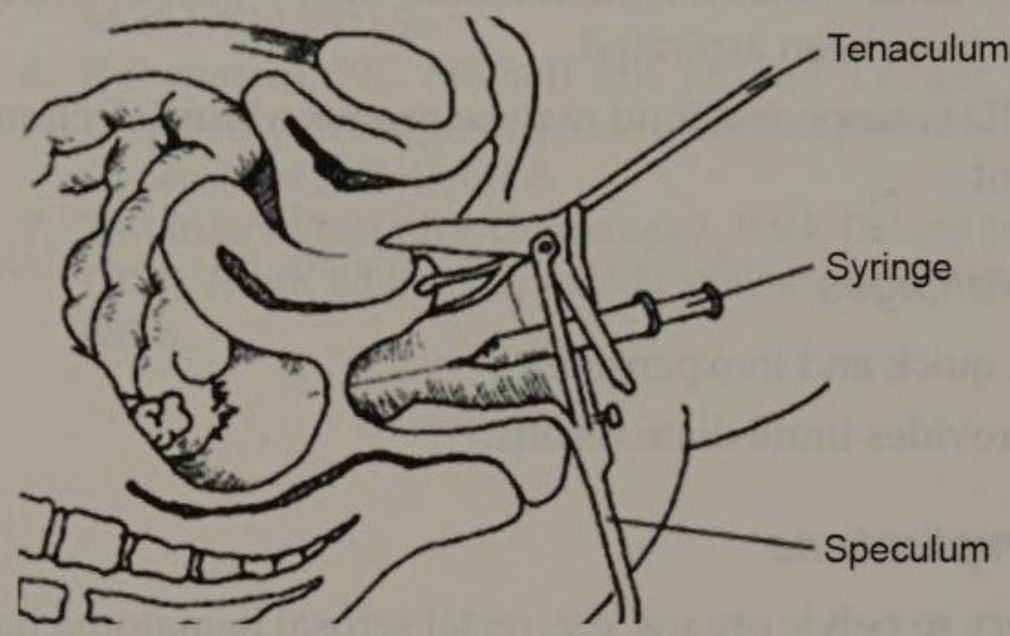

Fig. 33.1: Showing puncture of cul-de-sac

After explaining procedure to patient and getting an informed consent the technique is carried out step-by-step as given below. Patient should be positioned in a reverse 'Tredelenberg's position' (head up) for 15 to 20 minutes so as to allow fluid/blood to accumulate in the pouch of Douglas.

1. Patient is laid in dorsal lithotomy position as for pelvic examination.
2. A thorough bimanual per vaginal examination is done.
3. Sim's speculum is placed to retract posterior vaginal wall and cervix and vagina visualized.
4. Posterior lip of the cervix is grasped with a tenaculum and gently pulled to elevate the cervix and expose the posterior vagina.
5. 2 to 3 ml of air is drawn into the syringe before connecting to the 18- gauge needle.
6. Puncture vaginal mucosa in the midline about one cm. below its posterior reflection away from the cervix. The needle should penetrate below the uterus and cervix but above the rectum (Fig. 33.1).

7. Hold the needle and syringe horizontally and advance three to four cm through mucosa. Inject 2 to 3 ml of air. If there is resistance the needle has entered solid tissue and should be repositioned.
8. Aspirate
9. The procedure is terminated after aspiration of fluid or three dry taps.
10. If pus is obtained, keep the needle in place for a colpotomy.

Interpretation

If the fluid contains non-clotting blood, a ruptured ectopic may be suspected.

If the fluid contains clotted blood, then a vein or artery may have been aspirated.

If PID is suspected fluid may be examined for infectious agent.

Advantages

It is quick and inexpensive.

It provides immediate results.

Complications

Injury to pelvic organs, e.g. rectal serosal hematoma has been reported.[4]
Penetration of the pelvic vessels and tumor.

Colpotomy

A colpotomy is a procedure by which an incision is made in the vagina. It can be anterior or posterior depending upon whether the incision is made in the anterior fornix or the posterior fornix.

Indications for Posterior Colpotomy

1. Drainage of pelvic abscess.
2. Approach for tubal sterilization. It is rarely done these days but may be combined with a Manchester repair. Incidence of deep dyspareunia and pelvic infection is higher for this approach.
3. Removal of fibroids or myomas. They are sometimes removed vaginally by colpotomy. It can also be combined with a vaginal hysterectomy.
4. Laparoscopy followed by a colpotomy is the surgical option for vaginal extraction of pelvic cyst or mass.[5]
5. Laproscopic assisted vaginal hysterectomy combines three steps for the removal of the uterus, an initial laparoscopic stage, followed by a vaginal stage, and a final laparoscopic stage. Colpotomy is performed during the second step to deliver the uterus into the vagina.

Colpotomy Drainage of Pelvic Abscess

Posterior colpotomy is done to evacuate pus from the pelvic abscess present in cul-de-sac. There are three requirements for colpotomy drainage of pelvic abscess[6]:

1. The abscess must be midline or nearly so.
2. The abscess should be adherent to the cul-de-sac peritoneum and should dissect the rectovaginal septum to assure the surgeon that the drainage will be extraperitoneal and that the pus will not be disseminated transperitoneally.
3. The abscess should be cystic or fluctuant to ensure adequate drainage.

Procedure is essentially the same as that of culdocentesis. If pus is obtained on culdocentesis the needle is kept in place and a stab incision is given at the site of puncture. The needle is then removed and either the index finger or a blunt forceps is introduced through that incision to break the loculi in the abscess cavity. After the drainage of pus, soft corrugated rubber tube can be left in place and anchored with fine suture to allow adequate drainage.

In patients in whom above mentioned criteria are not met for colpotomy exploratory laparotomy may be required for the drainage of pus.

Complications

1. Injury to the rectum and large bowel.
2. Intraperitoneal rupture of the pelvic abscess.
3. Subsequent residual infection or symptom requiring major operative procedure.[7]
4. Injury to large vessels occurs rarely and is avoidable.

CONCLUSIONS

Culdocentesis is a technique to obtain free fluid from the cul-de-sac of women allowing direct examination of intraperitoneal fluid. The procedure is simple but finer points of the technique may improve results. Colpotomy is a procedure by which an incision made in the vagina allows drainage of a pelvic abscess and also helps removal of the uterus after laparoscopic hysterectomy.

Key Points

1. For culdocentesis positioning patient in a reverse 'Tredelenberg's position' for 15–20 minutes allows fluid/blood to accumulate in the pouch of Douglas.
2. Sim's speculum, tenaculum, 18-gauge spinal needle and 10ml syringe are all that are required for the procedure.
3. Abandon procedure after two to three dry taps.
4. If pus is aspirated keep needle in-situ for colpotomy and give a stab incision at the site where a bead of pus exudes.
5. Although colpotomy is mainly used for drainage of pelvic abscess, modern indications are as an adjunct to laparoscopy for retrieval of masses and/or uterus during laparoscopic hysterectomy.

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34

Skin and Muscle Grafts

Upender Sharma

INTRODUCTION

Reconstruction of the female perineum is appropriate for congenital absence of the vagina, lymphedema, vaginal fistulas, and ablative defects. Genital wound coverage involves special problems such as fecal contamination, difficult immobilization, and adjacent rectal and urethral repairs. Vaginal reconstruction after ablative surgery must, of necessity, take into account wound conditions different from those found in congenital absence of the vagina or created by transsexual surgery. Local abundance of well-vascularised tissue allows for grafting techniques in cases of congenital absence and transsexuality. Such is not the case following ablative surgery, in which large, bulky, well-vascularized flaps must be brought into the pelvic region.

CONGENITAL ABSENCE OF THE VAGINA

History

The history of attempts to form a vagina dates back to ancient times. Hippocrates described "membranes obstruction" of the vagina. Realdus Columbus in 1572 described vaginal aplasia. Dupuytren reported an attempt at surgical correction in 1817. The rectum and colon were first used to form a vagina by Sneguireff in 1892 (reported in 1904). In 1904 Baldwin described an, operation in which an ileal flap was used to function as a vagina. In 1904 labial grafts were first used by Jewett. Graves used the method of two thigh flaps and two labial flaps over a glass mould in 1908. These early attempts were associated with high rates of morbidity and mortality.

The nonoperative technique of intermittent perineal pressure was described by Frank in 1938. Wells (1935) and Kanter (1935) popularized the method of spontaneous re-epithelization of the vaginal tract over a stent placed in the rectovesical septum after blunt dissection of the space.

Skin grafting techniques to reconstruct the vagina were used by Abbe in 1898. Much later, McIndoe (1938) achieved excellent results with split-thickness skin grafts inverted over a stent, and this has remained the most popular technique to date.

The concept of using thicker grafts can be traced to a publication by Burian in 1935. In 1953 Conway and Stark emphasized the importance of thick grafts, recommending a thickness of 20/1000ths of an inch. They noted the relationship between thicker grafts and decreased graft shrinkage. "A free graft of thick split skin contains sufficient dermis to afford resiliency. Hence, the likelihood of contraction of the graft is lessened", they write. Fara, Vesely, and Kafka (1972) described the use of thick grafts harvested with a dermatome from the buttocks; however, this necessitated split-thickness grafting of the donor.

Diagnosis

The diagnosis of congenital absence of the vagina is frequently missed at birth and often does not become apparent until puberty. Estimates of the incidence vary from one in 4,000 to one in 80,000. If this diagnosis is made, the parents may desire counseling.

Occasionally a patient presents with an abdominal mass. The parents of a pubertal child will not be aware of the true diagnosis. On examination the patient is diagnosed to have congenital absence of the vagina or cervical agenesis and the mass is a hematocolpos/hematometra. In the past it was recommended that these patients undergo hysterectomy, since if the cervix is not

competent, it may not be functional and infection together with endometriosis leads to high morbidity and mortality However, new theories have provided an additional answer to this problem. If a vagina can be constructed to the cervix, and if the cervix has an endocervical canal and is competent, the patient can bear children successfully. On the other hand, if the cervix has no canal, the problem of endometrial proliferation still exists and hematometra with endometriosis is a problem The solution may lie *in vitro* fertilization techniques. If the uterus is kept intact and suppressive hormones are given to control endometrial proliferation, *in vitro* fertilization can be offered after marriage and the potential for intrauterine pregnancy remains. Cesarean section can then deliver a normal fetus. For this reason alone, a vagina should be constructed and the uterus retained until such time as the desirability, advisability, and practicality of pregnancy can be determined.

A careful physical examination of patients with congenital absence of the vagina should reveal evidence of secondary sexual characteristics. Internal genital anatomy must be determined before surgery. The high incidence of associated renal tract anomalies makes intravenous pyelograms a necessity, magnetic resonance imaging, cystoscopy, and retrograde pyelography may be needed. 3-D ultrasound and MRI are two investigative modalities which are most useful in the diagnosis of congenital anomalies of the female genital tract. Karyotype will differentiate between the testicular feminization syndrome and simple congenital absence of the vagina (Mullerian agenesis) (Fig. 34.1).

Fig. 34.1: Patient of vaginal agenesis

Surgical Techniques

Full-thickness Skin Grafts

It is found that full-thickness skin grafts for vaginal reconstruction are superior for certain types of deformity. They reduce the amount of time required for post-operative stenting, allow reconstruction at an earlier age, and minimize the risk of vaginal stenosis by decreasing postoperative vaginal contraction. Full-thickness skin grafts grow proportionately with the remainder of the body. This technique is applied primarily to vaginal agenesis, but is also useful in cases of male to female transsexualism, unsuccessful transsexual operations resulting in vaginal stenosis, and certain other intersex conditions and cases of iatrogenic disease.

When split-thickness grafts were used to construct the vagina, the cavity needed to be stented, dilated, and used sexually over a period of years to prevent stenosis. Therefore, in the past, vaginal reconstruction was not recommended until the patient was planning marriage. The diminished stenosis rates of full-thickness grafts allow vaginal reconstruction at an earlier age. It is recommended that congenital absence of the vagina be treated anytime after puberty when the anomaly is recognized. The patient can then have the psychologic reassurance that she is externally normal as she develops into adulthood.

Preoperatively, a full mechanical and antibiotic bowel preparation is made. Full thickness skin grafts are obtained from the lateral hairless groin areas bilaterally or from the gluteal crease. The groin donor site may extend from the pubis, parallel to the inguinal ligament, to beyond the lateral line. The donor sites are closed primarily. All extra fat is removed from the undersurface of the grafts which are sutured together over a stent. The stent is carved from a block of foam rubber and placed in a condom. Commercially available stents do not appear to conform well to the internal contours of the new vagina. The end of the condom is left open to facilitate its placement in the neovagina. The patient's labia are sutured to the lateral thigh skin to expose the introitus. A V-shaped, inferiorly based incision is used to dissect a flap made of introitus mucosa. This is later inserted into the new vaginal cavity and sutured to the grafts. The flap prevents circular scar contraction at the opening of the vagina.

The new vaginal pocket is dissected above the rectum and below the bladder to peritoneal cavity. The cavity is

made with blunt and sharp dissection so that an ample vaginal size is established. Care must be taken to avoid injury to the urethra and rectum. A finger in the rectum helps to identify the proper place for dissection. A catheter in the urethra assists in identification of the urethra, to avoid injury. The inferiorly based V-flap of vaginal mucosa is turned inward into the new cavity, and sutured as far cephalad as possible. The foam rubber stent covered by the full-thickness grafts is then inserted into the new tract, and the proximal open edge of the skin graft is sutured to the vaginal mucosa and the V-flap with 3-0 interrupted sutures. The labial tissue is sutured together with two 2-0 nylon mattress sutures to prevent extrusion of the stent and graft. Suprapubic urinary drainage is used instead of urethral catheter drainage to prevent pressure necrosis of the urethra.

Bed rest is prescribed for four or five days. On the fifth day the patient is returned to the operating room where, under general anesthesia, the stent is removed, the cavity is cleaned and irrigated, and the grafts are inspected. The stent is replaced and held stationary with a firm girdle. The labia are not resutured. After the first dressing change, most patients tolerate subsequent changes without anesthesia. The patient is given instructions on stent removal, daily sitz baths, and povidone-iodine (Betadine) douches and then discharged to continue this regimen.

After the first month, a stent of balsa wood covered with a condom or hollow acrylic is given to the patient to wear at night for three months. A trial period with total removal of the stent is then suggested. After the full thickness graft is stabilized, there is no further need for stenting.

Split-Thickness Skin Grafts

Mcindoe Technique

Preoperative preparation and intraoperative dissection are the same as for full-thickness grafts. In this technique, however, a full dermatome drum of split-thickness skin is taken from the buttock or lateral hip area. The thickness is usually 0.016 or 0.018 inch. The graft is sewn with its epithelial surface around a vaginal stent. The patient is kept at bed rest for seven days. Once confident of self-care, the patient is discharged. Sexual intercourse is permitted after six weeks. The patient is instructed to wear stent continuously for at least six months, except during intercourse and douches (Figs 34.2 to 34.6).

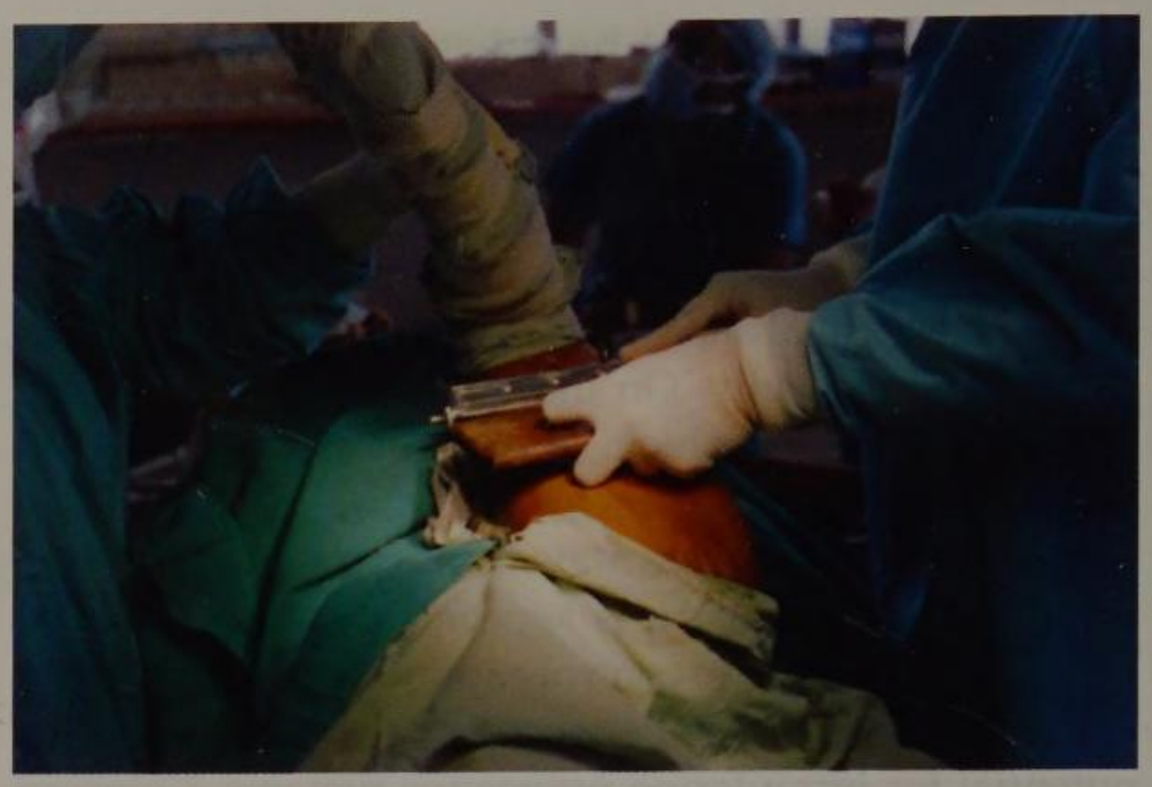

Fig. 34.2: Graft being taken

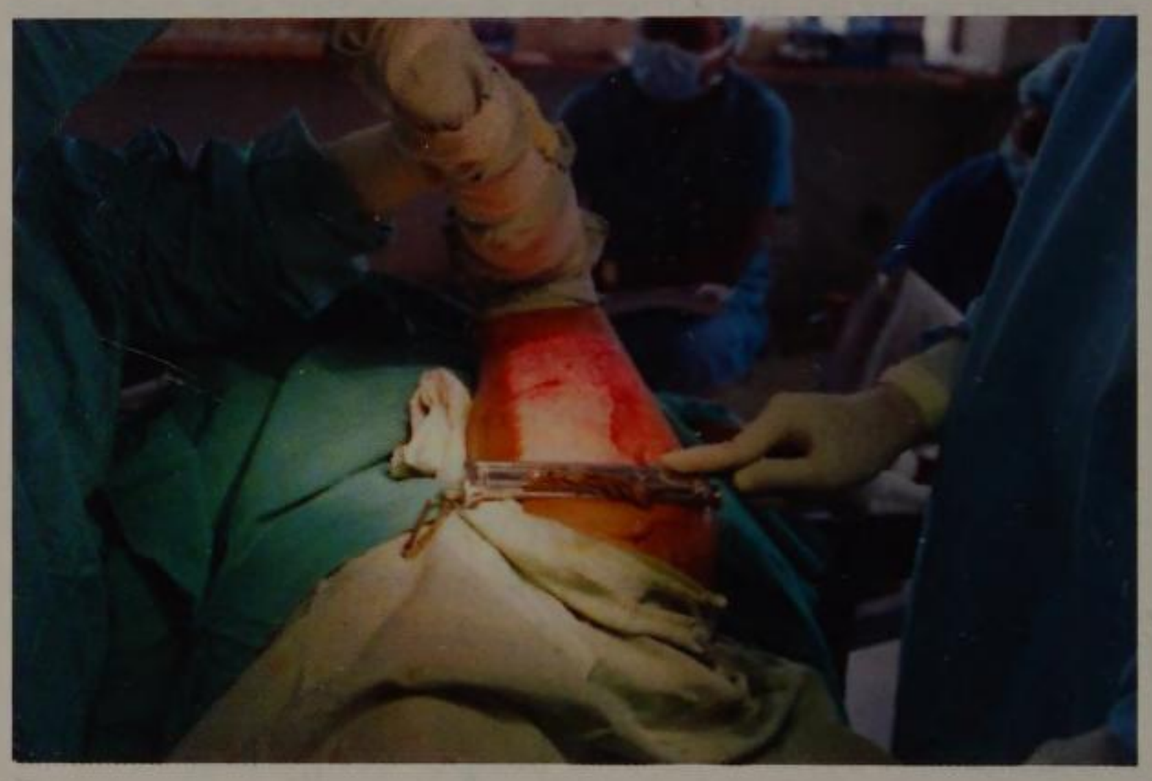

Fig. 34.3: Graft being taken

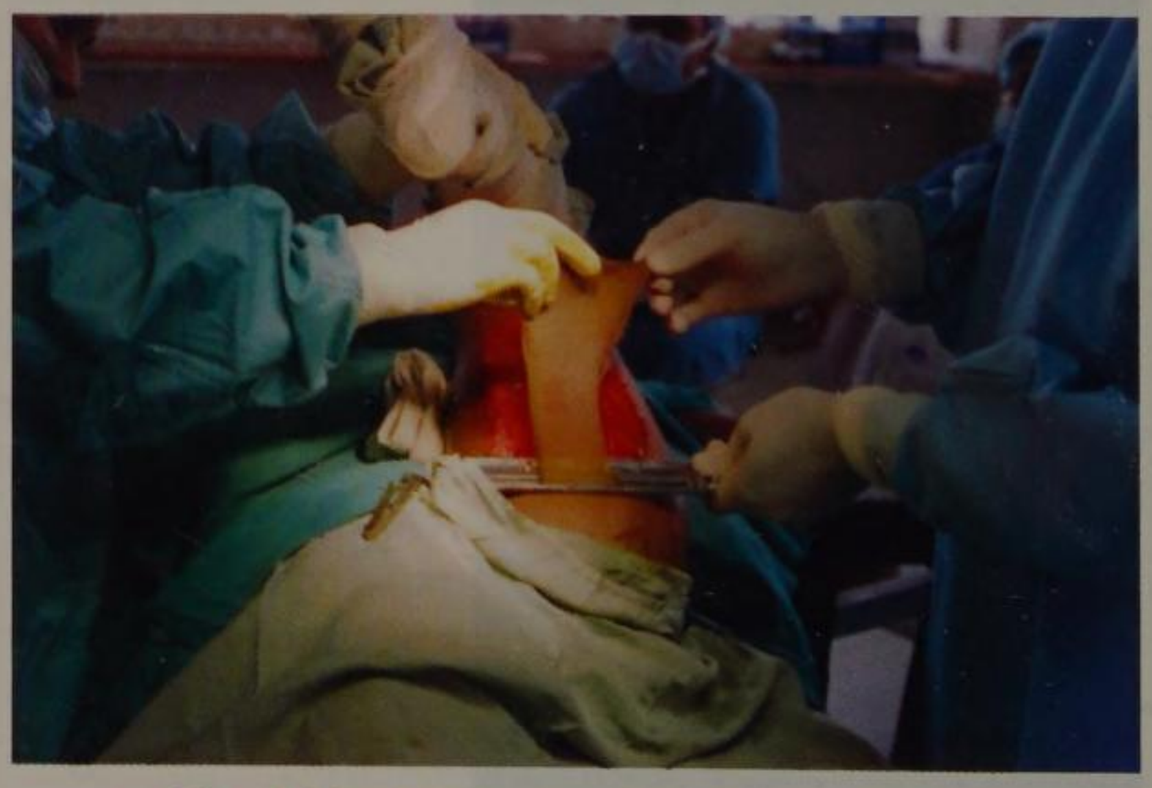

Fig. 34.4: Split skin graft being harvested

Fig. 34.5: Skin graft donor area defect

Fig. 34.6: Sheet of skin graft being spread showing dermis

Intermittent Perineal Pressure: Frank Technique

In the Frank technique, intermittent perineal pressure is applied with vaginal dilators graduated in size to create and stretch the vaginal canal. The smallest dilator is placed at the dimple between the anus and the urethra, and pressure is applied until the patient feels mild discomfort. The pressure is relieved and then applied again. This process is continued over a period of weeks until the largest vaginal dilator can be introduced and worn comfortably. Independent corroboration of the success of this procedure is not widespread.

Intestinal Flaps

Intestinal segments have been used in the creation of a vagina with varying degrees of success; portions used have included the small intestine, ascending colon, sigmoid colon, sigmoid and lower rectum.

The patient should be in the hospital two days before the operation in order to prepare and sterilize the bowel adequately. With the patient in a lithotomy position, a vaginal tract is first dissected from the perineum into the peritoneum and the tract widened laterally. When hemostasis is satisfactory, the vaginal tract is packed and the abdomen opened. The sigmoid is generally mobile enough to allow a satisfactory vascular pedicle to develop. With proper planning, an adequate length of intestine (12 to 15 cm) can be isolated, an oblique end to end anastomosis performed, and the bowel segment drawn through the vaginal tract. The patient is returned to a lithotomy position. The end of the bowel is scalloped to gain additional room, and then attached to the introitus.

Complications and Comparisons

Failures with the split-thickness technique are frequently due to hematomas, resulting in graft loss, or early removal of the stent by noncompliant patients. This causes excessive contraction, decreasing the size of the cavity.

Ortiz-Monasterio and associates (1972) reported good results in 17 out of 21 reconstructions with the split technique. Of 32 patients who underwent the McIndoe operation (Thompson, Wharton, and Te Linde, 1951) satisfactory results were noted in 81 percent; there were three rectovaginal fistulas, two urethral sloughs, and one postoperative hemorrhage. Garcia and Jones (1977) reported satisfactory results in 41 out of 43 patients treated with the split technique. Cali and Pratt (1968) noted seven complications and ten patients who required reoperations out of 123 patients; of 93 individuals who responded to questions about sexual function, 84 (90%) said that function was satisfactory.

Complications of the split-thickness technique include stenosis, loss of the graft, rectovaginal fistula, and uretherovaginal fistula.

Squamous carcinoma has been reported in vaginas reconstructed from skin grafts. Careful yearly follow-up examination is recommended to monitor the graft for any signs of malignant degeneration.

The advantage of using a portion of the intestine to line the vaginal canal is that there is no need for frequent dilatation or stent wearing. The disadvantages of intestinal transfers include excessive mucus formation, especially with grafts from the small intestine, and a mortality rate between 1 and 2 percent.

The disadvantages of the Frank technique of intermittent perineal pressure include the need for prolonged, periodic dilatation, and often inadequate results (the vagina being too short in depth).

The full-thickness graft technique is an advance beyond the split-thickness procedure. The latter technique requires stenting for periods of up to one year, and has a tendency for contracture when the stent is removed or when the patient does not have vaginal intercourse.

The favourable qualities of full-thickness skin grafts, well known in eyelid, hand, and hypospadias surgery, are the abilities to grow with the patient and to resist contracture. The same principle applies in the vaginal area. Once the vagina tract is established with a full-thickness graft, the vagina does not contract; it grows at the rate of the remainder of the body and does not require prolonged stenting. Significantly, the small linear scars from the bilateral inguinal donor sites are much more esthetically acceptable than the scars in the split-thickness donor sites in the thigh or buttocks. The size of donor sites required and their exposed locations create significant problems for the patients. Also, split-thickness donor sites have pigmentation irregularities in exposed areas. There is an additional risk of hypertrophic scar formation when split-thickness grafts are used.

Full-thickness skin grafts are superior for certain types of vaginal reconstruction. Their advantages include decreased contraction, a shorter period of postoperative stenting, correction at an earlier age, a lower risk of vaginal stenosis and a cosmetically more acceptable donor site. In addition, the patient has the psychologic reassurance that she is normal as she develops through puberty and adulthood.

VAGINAL RECONSTRUCTION AFTER ABLATIVE SURGERY

History

Early Greek and Roman reference to attempts at formation of the vagina relate largely to congenital absence. Up to one-third of all patients treated for cervical cancer develop a recurrence, and in most the process is totally confined to the pelvis. Exenterative surgery for pelvic malignancy has been more useful in modern medicine, and in spite of the radical surgery necessary, the operative mortality rate remains low. The recent success of radiation therapy has decreased the need for exenteration. The plastic surgeon is invaluable in helping repair the defects created by this extirpation. Radiation therapy, with resultant fibrosis and decrease in blood supply, further complicates reconstructive efforts in this area. Bulky, highly vascular flaps transferred to this area fill the pelvis and offer the greatest chance of successful primary healing.

Surgical Technique

In 1953 Conway and Stark reported on the use of random gluteal and thigh pedicle flaps after radical pelvic surgery for carcinoma and irradiation. Pratt and Smith (1966) described the use of sigmoid loop for vaginal reconstruction following ablative gynaecologic surgery. The large gluteal flap that had previously been delayed was rotated into the perineal defect. This procedure was not used primarily at the time of resection. The donor site of the gluteal flap was closed with a split-thickness skin graft.

Many methods have been proposed to repair these large, resulting defects. It is necessary to bring in a blood supply through a myocutaneous flap and reconstruct the vagina at the same time as the pelvic defect is covered. The use of immediate vaginal reconstruction fills the pelvic floor and decreases the incidence of postoperative infection and small bowel obstruction. Delayed techniques for vaginal reconstruction can result in extreme difficulty in trying to dissect the space and plane without injuring the bowel that has become adhered to the adjacent pelvic walls and structures. The use of myocutaneous flaps decreases the morbidity and mortality rates of the original procedure and ensures a much smoother postoperative course.

Patients with a vulvar defect from extensive leukoplakia or carcinoma also are candidates for the use of myocutaneous flaps. To pull the tissue lateral to the defect into the vagina, where hair becomes an irritant and the introitus is destroyed is no longer adequate for reconstruction. The use of a gracilis myocutaneous flap or an inferiorly based rectus abdominis myocutaneous flap has become routine in repairing large labial defects.

The gracilis myocutaneous flap is commonly employed for lower pelvic defects seen after total pelvic exenteration and abdomino-perineal surgery. The low axis of this flap does not always allow transfer into the upper pelvis. It does, however, extend with confidence to the

prominence of ischial spine. The transverse and vertical rectus adbominis myocutaneous flaps add a high arch of rotation and allow them to obliterate massive dead space in high pelvic reconstruction. The rectus abdominis myocutaneous flap is supplied by the deep inferior epigastric vessels. The axis of this flap is determined by the location of these vessels and is usually transferred as a pure island flap through the posterior rectus sheath, rather than through the midline. The flap can be tubed to make a vagina, or the rectus abdominis muscle alone can be used as a muscle flap when the cutaneous segment is not needed. This flap can be used to reinforce suture lines in bladder sphincter repair, fill dead space to aid the surgical correction of incontinence, and produce an elevation of the mons in females with exstrophy. The gracilis myocutaneous flap has a high survival. The rectus abdominis flap is even more reliable; it is larger and reaches higher positions in the pelvis, but it does require a laparotomy to insert into the pelvic defect. The gracilis flap can be used to correct a vesicovaginal fistula or to correct labial and lower vaginal deformities without the need for a laparotomy. Closure of both donor areas is not difficult, unless it is necessary to carry a large amount of rectus fasica with the muscle. The use of gracilis flaps or inferiorly based rectus abdominis myocutaneous flaps had been a significant advance in the treatment of pelvic and vaginal malignancy. To obliterate pelvic dead space and to repair massive defects of the perineum, groin, and pelvis, the surgeon should be familiar with the advantages and disadvantages of these flaps in order to work as a team with the extirpative surgeon.

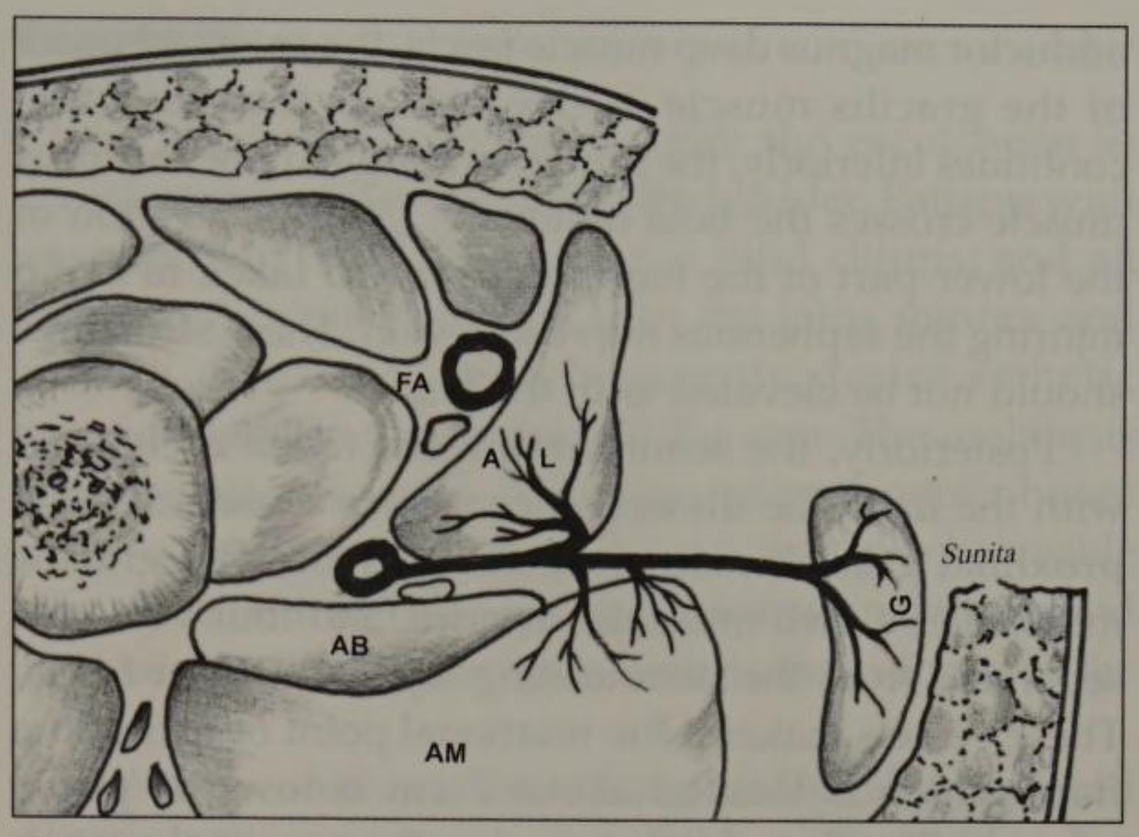

Fig. 34.7: Diagram of the vascular supply of the gracilis (G). Branches of the vascular pedicle enter the deep surface of the adductor longus (AL), and inconstant branches supply the adductor magnus (AM). By dividing these branches, a 6 to 7 cm long pedicle can be isolated. FA, Femoral a: AB, adductor brevis (Redrawn from Manktelow RT: Microvascular Reconstruction, p. 43, Springer-Verlag, New York, 1996)

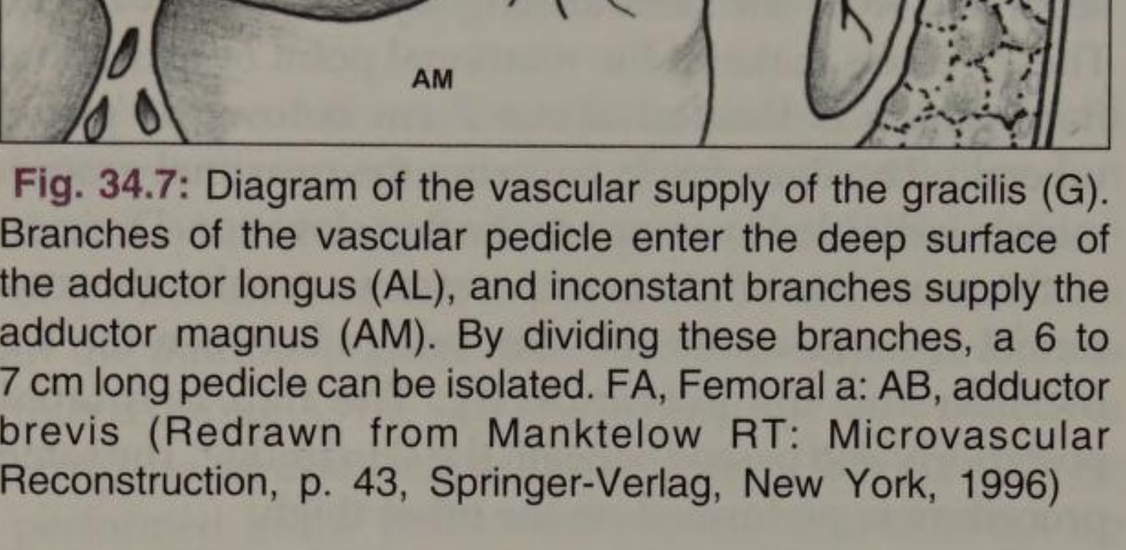

Fig. 34.8: Anatomical relationships of G. gracilis: AL, adductor longus; AM, adductor magnus; S. Sartorius; ST, semi-tendinosus; VM, vastus medialis. Location of the main vascular pedicles: FA, femoral PFA, profunda femoris a; SA, distal continuation of saphenous a. (Adapted from Manktelow RT: Microvascular Reconstruction, p. 39, Springer-Verlag, New York, 1986)

GRACILIS FLAPS

McCraw and associates first reported the use of the gracilis myocutaneous flap for vaginal reconstruction in 1976. The patient is placed in a modified lithotomy position. The flap is outlined while the patient is awake; the anterior border of the flap lies on a line between the proximal adductor longus. The cutaneous portion of the flap extends 6 to 9 cm posterior to this line and is centered over the gracilis muscle. The flap is usually 20 to 25 cm is length and does not extend into the distal third of the thigh (Figs 34.7 and 34.8).

Elevation of the flap is begun proximally, first identifying the adductor longus tendon and its fascia. The adductor longus and adductor magnus muscles are then dissected, exposing the proximal neurovascular pedicle of the gracilis muscle. The neurovascular pedicle is surrounded by a layer of fascia that separates the adductor brevis and longus muscles. After identification of these structures, palpation is used to finally confirm the fascia that covers the adductor longus distally, is incised to further outline position of the gracilis muscle. Together with the adjacent adductor longus and

adductor magnus deep muscle fascia, the anterior border of the gracilis muscle is elevated. As the dissection continues inferiorly, the posterior margin of the sartorius muscle crosses the field obliquely. During elevation of the lower part of the flap, care must be taken to avoid injuring the saphenous nerve and vein. These structures should not be elevated with the flap.

Posteriorly, the semimembranous fascia is elevated with the flap. The dissection continues cephalad to the proximal gracilis neurovascular pedicle. The gracilis motor nerve, two muscular arteries, and four veins are separated from the surrounding layer of areolar fascia. These vessels makeup the rotational point or axis of the flap, which is located about 7 cm below the pubic tubercle. The deep fascia covering the proximal gracilis muscle is divided to complete the flap elevation. Division of the muscular origin is unnecessary. A subcutaneous tunnel is made under the skin bridge between the leg incision and the pelvic cavity. The flap is rotated posteriorly and passed beneath the skin bridge. The same procedure is performed on the other thigh.

The excess skin and fat is removed from the margin of the flaps, which are sutured into a pouch-like configuration, with the skin side facing internally. The new vaginal pouch is rotated caudally into the pelvic defect. The tendious ends are then anchored to the presacral fascia. The distal ends of the flaps become the apex of the vagina, and the proximal ends become the vaginal introitus. The new vaginal cavity is usually 13 to 15 cm in depth and 12 to 14 cm in circumference. The donor sites are closed primarily.

Occasionally, it may be difficult to center the skin when outlining the flap because of thigh obesity, poor muscle tone, or inadequate hip abduction. An intraoperative solution for this problem was reported by Freshwater (1988). In McCraw's technique a subcutaneous tunnel is made to pass the flap from the thigh to the perineal wound. To help identify the gracilis muscle, finger dissection from the perineal wound to the origin of the gracilis along the inferior pelvic ramus is performed. Because of the long and strap like configuration of the gracilis, its superior and inferior edges can be easily palpated through the tunnel. Accurate flap design can then be achieved from direct muscle belly palpation, bypassing the problems of obesity, poor muscle tone, or inadequate hip abduction.

Two other methods of intraoperative identification of the gracilis muscle have been reported. The first is to make a 5 cm transverse incision in the upper thigh at the proximal margin of the flap so that the progression of muscles from the abductor longus to the gracilis and to the semimembranosus can be seen. The second method is to identify the muscle at the distal margin of the flap through a second transverse incision to establish the position of the sartorius, gracilis, and semitendinosus and semimembranosus muscle from above, down. When both methods are used, the gracilis tendon can be elevated out of the distal portion of the wound. This causes the muscle to "bowstring" and outline the area of skin lying over the muscle. This also has the benefit of allowing further confirmation of the location of the gracilis muscle origin in the proximal transverse incision.

Vasconex, Bostwick and McCraw (1974) also reported the use of rectus abdominis myocutaneous flaps to reconstruct the vagina after extirpative surgery. This technique had proved reliable and is the method of choice for reconstruction in many high pelvic defects.

Stenosis

When radiation has caused such extensive scarring that the vaginal cavity is obliterated, it is possible to create a new vagina if the desired tract can be safely constructed. Unfortunately, adhesions in the pelvis make surgery for a new channel dangerous. Suturing the labia together to produce an external vaginal pouch has been recommended in these extreme cases (William's vaginoplasty).

If the patient is uncooperative or the stent is removed prematurely for any reason, stenosis, either complete or partial, may result. An attempt should be made to dilate whatever channel is present, but if this is unsuccessful, further surgery with reopening of the vagina is indicated. Full-thickness grafts should be used to resurface the cavity. Stent retention is mandatory for success.

Vaginal Fistulas

Obstructed Labor is still commonest cause in India. Trauma is also a common cause of vaginal fistulas. They may be due to unrecognised or unrepaired injury at the time of the surgical or gynaecologic procedures. A high index of suspicion is recommended at the time of surgery to prevent fistula formation.

When located in the middle or distal third of the urethra, urethrovaginal fistulas may not be associated with incontinence, but the patient is likely to complain of vaginal discharge at the time of urination and of post-micturition dribbling.

The Symmonds and Hill (1978) technique remains popular. Rather than simply separating the urethra from the vagina and closing the two structures, a large

U-shaped flap of vaginal mucosa containing the fistula is elevated. The fistula is closed, reinforced with pubococcygenus muscle or bulbocavernosus fat pad, and the flap is sutured to its original location.

When local tissues are compromised by radiation or scar, the interposition of a robust flap such as the gracilis or gluteal thigh flap between uroepithelium and the vagina helps to ensure primary healing. A well-vascularized flap reinforces the two separate suture lines, thereby preventing recurrent fistula formation.

Vesicovaginal fistulas are common subsequent to injury from cesarean section, hysterectomy, or unrecognised trauma at the time of previous surgery. Post-operative necrosis of small areas of bladder may occur secondary to the trauma or devascularization as a result of suturing. The possibility of multiple fistula must always be considered.

Several excellent types of repair are popular. However, interposition of robust flaps as in the urethro-vaginal repair is of particular benefit in cases of recurrence. The inferiorly based rectus adbominis muscle flap is ideally suited for reinforcing both bladder and vaginal walls after their repair.

Lymphedema of the Vulva

Just as there is lymphedema of the penis and scrotum in males, there can be lymphedema of the vulva in females. These patients have extremely large lateral protuberances of the vulva, the clitoral hood, and the vaginal tissues that cause excoriation, odor, and extreme physical displacement of the vaginal introitus. The cause of this condition usually is not similar to that of male lymphedema in the genital area, but rather relates to obstruction of the lymphatics in the labia due to chronic infection. Filariasis or leprosy are not found commonly in this area. Radiation and tumors are occasionally implicated, but the most common cause of lymphedema is idiopathic. The treatment for lymphedema of the labia is simple vulvectomy. If the vulva is so involved that the excision involves vaginal tissue, it is not desirable to pull the hair-bearing skin of the perineum into the vagina, because irritation will occur, and a chronic cyclic sequence of events will result in further lymphedema. Instead, reconstruction of the labia should be completed with either rectus abdominis or gracilis flaps so that circulation and lymphatic flow from a base outside the involved area can be secured. These myocutaneous flaps allow lymphatic distribution from the labial area to be taken into the circulation of the flap to bypass the obstructed labial area.

Exstrophy

There are peculiar problems with the escutcheon in females born with exstrophy of the bladder. Patients with exstrophy have displaced hair, a bifid clitoris, and an abnormally wide introitus with the labia minora and majora displaced; they frequently desire esthetic improvement in the contour of the area. The umbilicus must be reconstructed. The wide-splayed public bones cause a depression in the mons area that may be visible through clothing. This is particularly true in dancers and individuals who must wear clothes that adhere to the pelvis.

W-flaps can be created to bring the laterally displaced hair over the superior portion of the public midline, but these are not always necessary in females. Wide excision of the midline scarring to join the bifid clitoris and labia in the midline is more desirable; the wide introitus is thus reduced. As the scar progresses over the public area onto the abdominal wall, a large Z-plasty can be performed in the public hair-bearing area to break up the scar and produce a better mons prominence. Occasionally the patient desires more elevation of the mons; in this case a rectus abdominis flap can be used based on the inferior epigastric artery, and the muscle, without skin, can be transferred to the mons area to produce an elevation. If appropriate a large bone graft can be taken from the iliac crest and secured to the public area bilaterally, to give contour to the public symphysis. The patient should be instructed above the possibility of vaginal delivery in case of pregnancy, because the bone graft may not expand like a normal pelvis. There are no reports of vaginal delivery in patients with epispadias or exstrophy who have had bone grafts to the pelvis. Cesarean section is probably indicated for these patients.

CONCLUSIONS

Reconstruction of the vagina and female perineum is done for congenital absence of the vagina, lymphedema, vaginal fistulas, radiation induced vaginal stenosis and after exenterations. Well-vascularised tissue allows for grafting techniques in cases of congenital absence and transsexuality. Following ablative surgery and radiation, large, bulky, well-vascularized flaps must be brought into the pelvic region for optimal results.

Key Points

1. Full-thickness skin grafts for vaginal reconstruction are superior as the risk of vaginal stenosis is manimized.
2. Full-thickness skin grafts grow proportionately with the remainder of the body and is useful in vaginal agenesis and in male to female transsexualism.
3. When split-thickness grafts are used to construct the vagina, the cavity needs to be stented, dilated and used sexually over a period of years to prevent stenosis.
4. Congenital absence of the vagina should be treated anytime after puberty with full thickness grafts and the procedure need not wait until marriage.
5. The plastic surgeon is invaluable in repairing defects created by exenterations and radiation therapy.
6. The gracilis myocutaneous flap is commonly employed for lower pelvic defects after total pelvic exenteration and abdomino-perineal surgery.
7. Vaginal fistulas, lymphedema of the vulva and extrophies are other gynaecological conditions amenable to treatment by skin and muscle grafts.

SUGGESTED READING

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35

Creation of Neovagina

Gita Radhakrishnan, Gunjan Singh

INTRODUCTION

Vaginal agenesis is an uncommon condition, with an incidence ranging from one in four thousand to one in ten thousand[1]. Congenital absence of uterus and vagina, also called mullerian agenesis or Mayer – Rokitansky – Kuster- Hauser syndrome, is the most common factor requiring creation of neovagina.[1-3] Mullerian development is distinct from ovarian development and thus mullerian agenesis generally occurs without affecting the ovaries.[1] However, creation of neovagina may also be considered after vaginectomy, as from carcinoma, after extensive scarring from trauma or infection, or in the case of male to female trans-sexual surgery.[4-8]

In order to correctly treat the patient with vaginal agenesis, proper assessment of the underlying condition is imperative. Any associated congenital anomalies of renal origin should be documented. Detailed and careful counseling should be provided regarding the expected outcome of the surgery. Surgical creation of a new vaginal tract, or the neovagina, has been tried with variable results for more than a century. The first few major surgeries for creating a new vagina were described in the early years of twentieth century. They worked on the core principle of using a part of the ileum, sigmoid colon or rectum to create a pouch with an external opening. The morbidity associated with these procedures was so high that minor symptoms like bleeding and leucorrhoea during coitus were not considered significant enough. Although there were modifications in the techniques, the major areas requiring improvement remained the same. A breakthrough in this field was the use of a split thickness skin graft for covering the neovaginal channel introduced by Abbe in 1898. It was nearly forty years later that Sir Archibald McIndoe, a renowned plastic surgeon, first modified and popularized Abbe's technique into a much less debilitating surgery which soon became the most frequently performed procedure for creation of artificial vagina. An insight into problems faced by the previous procedures and their remedies was provided by him.

VAGINAL AGENESIS

Presenting Complaints

The history can vary according to the patient's age, her social support, awareness of a problem and her marital status.[1]

1. Primary amenorrhoea: Often in a young girl, failure of menarche can be the presenting complaint.
2. Difficult or painful intercourse: More commonly in married patients, the presenting complaint can be difficult intercourse. In most of these patients, menarche had never occurred, but they were too ignorant or shy to come up with the problem. This is not an uncommon scenario in the developing world. On examination, urethral meatus will be dilated in many of these patients after attempts of unsuccessful penetration. Symptoms of urinary tract infection can be very common in these patients.
3. Failure to conceive: "Infertility" can also be a presenting complaint in these patients.
4. Post surgery or massive radiotherapy: These patients have a previous history of a gynecological malignancy. It is important to note that many of them are not suitable candidates for the McIndoe's and other surgeries may be required.
5. Gender identification difficulty: Still very uncommon in the developing world, gender reassignment surgery is emerging as an important indication of neovagina creation. It is however, important to note

that this surgery is a component of the overall psychological and hormonal interventions the patient receives.

Diagnostic Workup

The diagnostic workup is of paramount importance and every indicated investigation should be carried out in order to prevent any surgical mishap or medico-legal complication.

1. Clinical examination: A thorough physical examination, including appraisal of secondary sexual characters and any possible endocrinopathy, recto-abdominal examination should be done.
2. Chromosomal analysis: A complete chromosomal analysis should be performed in all patients. SRY analysis for Y chromosome should be done when ovarian dysgenesis, androgen insensitivity syndrome or a Mayer-Rokitansky-Kuster-Hauser variant is suspected.
3. Renal evaluation: In all cases, intravenous pyelogram(IVP) or USG to know the position of the kidney is very essential. Sometimes a low-lying kidney can be accidentally damaged when creating a space between the rectum and the urethra. An IVP also helps in evaluating spinal abnormalities.

In presence of a pelvic mass, a USG also helps to differentiate hematometra from hematocolpos, endometrial or other cysts and pelvic kidney.

Timing of Treatment

Development of a neovagina need not wait till the time of anticipated marriage or coitus, as many times several months are required for the postoperative pain, edema and tenderness to subside. Once the diagnosis of a patient has been made with surety and the need for neovaginal construction has been determined, the surgeon should have a detailed discussion with the patient and her family regarding the diagnosis, treatment options available, the techniques of aftercare and the length of time involved. Treatment should not be usually started until any serious relevant psychological problems have been catered to successfully.

Psychological Preparation

Many of these patients are not prepared for the fact that "there is something wrong with them". The young girls are hardly in their late teens and denial and grief are the first responses both for them and their mothers. Counseling should emphasize that normal sex life will be possible after the creation of a neovagina. As for the infertility, the patient should be told about assisted reproductive technique and surrogacy. The patient's confidence is done a world of good by knowing that she has normal ovaries and her ovum can be taken to create her biological offspring. Psychiatric reinforcement and counseling can be helpful in these cases.

The patient should be willing for prolonged follow-up and should be motivated to continue dilating procedures at home.

If married, the husband should also form an integral part of the counseling.

Methods for Creation of Neovagina

The timing of creating a neovagina is elective and can be done anytime after the patient is emotionally mature. Often the appropriate time is few months before marriage.

Non-surgical

Intermittent pressure on the perineum can be used to create neovagina. This may be the first line treatment in a strongly motivated patient with a recognized perineal indentation or shortened vagina. Ingram's method of progressive dilatation passively with increasing the size of the dilator has been proven effective in few cases.

Surgical Intervention

Surgical methods for creating an artificial vagina are shown in Figure 35.1. The choice between the surgeries depend on the indication and the surgeons' comfort with a particular technique.[9]

The McIndoe Procedure[10-13]

It is primarily a procedure to create a neovaginal space with the help of a partial thickness skin graft and a mould. However, patient's co-operation and willingness to follow instructions in the postoperative period and long-term wearing of a vaginal mould play an essential role in the success of this procedure. McIndoe gave three principles for creation of artificial vagina:

i. Creation of an adequate space in the area between the rectum and the bladder.
ii. Inlay split skin grafting.
iii. Prolonged and repeated dilatation of the artificial vagina till the contractile phase of wound healing is over.

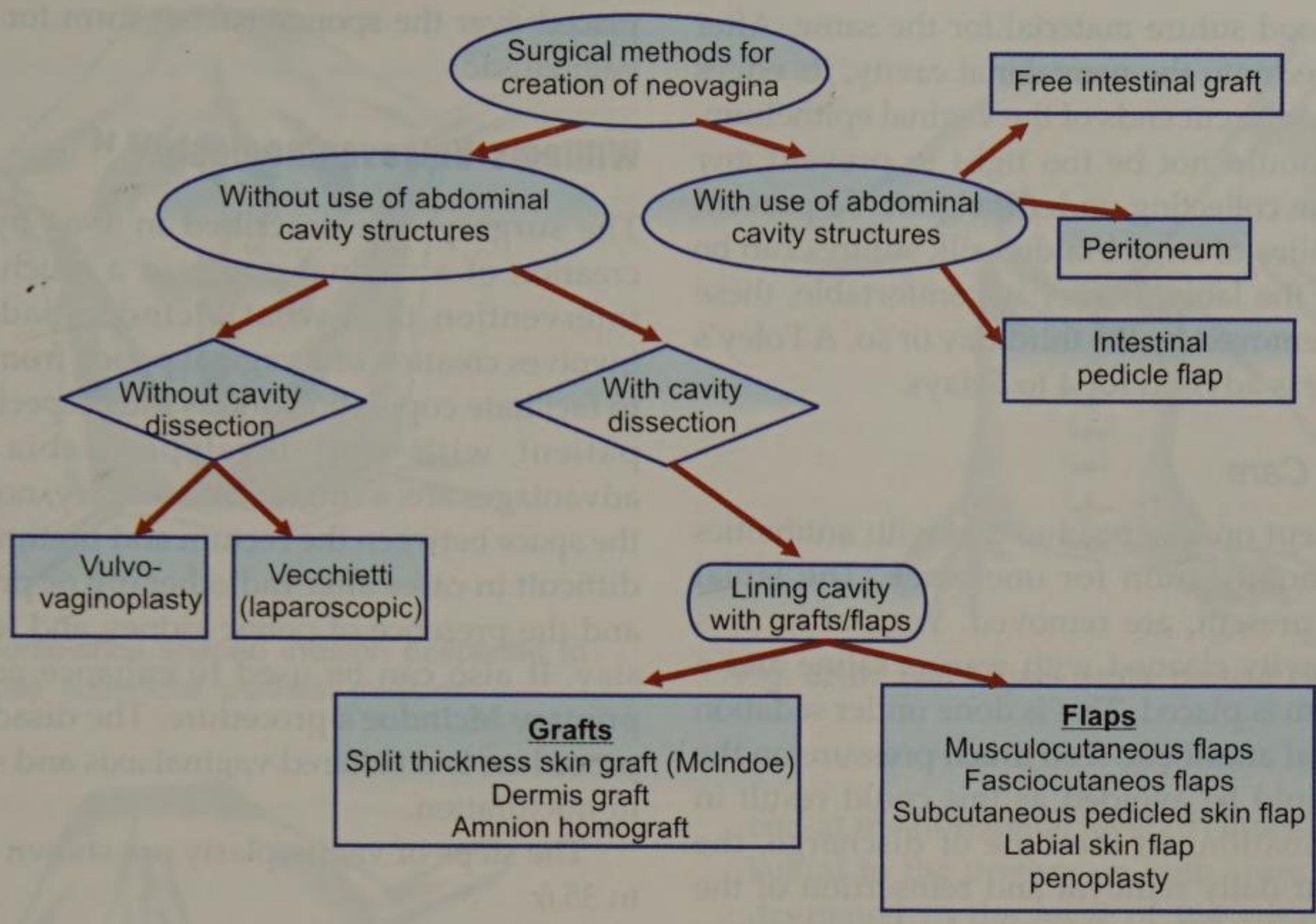

Fig. 35.1: Surgeries for creating artificial vagina

There have been many variations in the basic technique but the basic steps and the principles of the surgery are the same as initially popularized by Sir McIndoe. The credits for the devising and modifying the surgery are shared between Abbe, Wharton, McIndoe (therefore the name Abbe-Wharton-McIndoe procedure), Jayes, Banister, Heppner, Counseller and others at various point in the last sixty years.

Steps of Surgery[13]

Taking the Graft

The Reese electric dermatome is used to procure the graft. A split thickness graft of about 18/1000 of an inch is adequate. The site from which the graft is procured is generally the buttock so that it could be covered in swim wear. With the patient placed in Sim's position the donor site is shaved and skin prepared. The assistants hold the skin tightly and a10 cm wide and 24-26 cm long graft is procured.

Creating Neovaginal Space

In lithotomy position, a transverse incision is made at the site of the absent vagina. The incision should be placed posterior to protect the urethra. On one of the sides of the median raphe, the condensed tissue between the bladder and rectum is separated by blunt dissection. Any midline condensed band can be snipped with scissors. After extending the dissection adequately upwards and laterally, a sufficient enough neovaginal space is created, the upper extent of which is adjacent to the peritoneum. Too much dissection into the peritoneum is avoided as it can lead to enterocele formation. The cavity should be kept dry. Although there are no major bleeders, lateral walls can have few bleeders that could be ligated as and when required.

Preparing Vaginal Form

Various materials are available to create the vaginal prosthesis. Normal form rubber is a good and satisfactory material. The forms are cut into sizes of 10x10x20 cm and can be sterilized for use. Intraoperatively, there shape can be trimmed down to twice the size of the desired future vaginal cavity. The vaginal form thus prepared is compressed by covering with two condoms.

Sewing the Graft over Vaginal Form

The skin graft is sutured onto the vaginal form taking care that the epithelial side is inside. Delayed absorbable

vicryl 3-0 is a good suture material for the same. After the graft is placed into the neovaginal cavity, its edges can be sutured to the cut ends of the vaginal epithelium. The suturing should not be too tight to prevent any seepage of serum collecting under the graft. To prevent extrusion, few bites of large braided silk sutures can be placed through the labia. If very uncomfortable, these sutures can be removed by the third day or so. A Foley's catheter in place is advised for 4 to 5 days.

Postoperative Care

The patient is kept on low residue diet with antibiotics and minimal mobilization for one week. The labial sutures, if still present, are removed. Vaginal form is removed, the cavity cleaned with warms saline and a new vaginal form is placed. This is done under sedation and without local anesthetic .Too much pressure on the peritoneum should be avoided as this could result in enterocoele formation. At the time of discharge, the patient is taught daily removal and reinsertion of the form and cleaning of the neovagina by low-pressure douche. The form should be removed only while micturation or defecation and should be worn all the day and night. Dentine forms are easy to use and are given to the patient after 6 weeks. In the following 12 months, the patient is instructed to use the form only at night. If there is no change in the vaginal caliber, the form can be continued intermittently until frequently regular sexual activity is started after marriage.

Complications and Modifications done to Avoid them

The surgery has evolved over the years due to ingenious modifications to a state that it has a good success rate and the complications are less frequent. Fistula formation in the postoperative period due to pressure necrosis of anterior rectal wall or vaginal walls can occur in some cases. It has reduced after introduction of suprapubic catheter and foam rubber form. Initially balsa vaginal form was used but with the introduction of foam rubber form, the results have improved substantially. Failure of graft uptake and postoperative infection are also causes of concern. Granulation tissue formation can be managed by silver nitrate application in earlier cases and curettage in moderate cases. Use of X type perineal incision and perforated vaginal mould has been recommended by Ozek. Counseller- Flor modification uses a condom placed over the sponge rubber form for creation of the vaginal sac.

Williams Vulvovaginoplasty[13,14]

The surgery was described in 1964 by Williams for creation of a vaginal pouch in a much less extensive intervention than what McIndoe had suggested. It involves creation of a vaginal pouch from the labial skin to facilitate copulation and is thus especially useful in a patient with well-developed labia majora. The advantages are: a single stage surgery; no dissection into the space between the rectum and urethra, which can be difficult in cases after radiotherapy or previous surgery and the presence of pelvic kidney and lesser in-patient stay. It also can be used to enhance an unsuccessful primary McIndoe's procedure. The disadvantage of the procedure is an altered vaginal axis and slight difficulty in micturation.

The steps of vaginoplasty are shown in Figures 35.2 to 35.6:

1. *Initial horse shoe-shaped incision creation:*
   Local infiltration of labia and fourchette with 1:200,000 adrenaline and saline is done. Using two pairs of Allis' forceps, the labia minora are distracted laterally. A horse shoe-shaped incision is placed starting from the fourchette, dividing it and extending both ways up just inside of the labia majora's hair line (Capraro and Gallego have advised a modified U-shaped incision, which results in a more normal looking vagina and there is no trapping of urine in the vaginal pouch).An ideally placed incision should

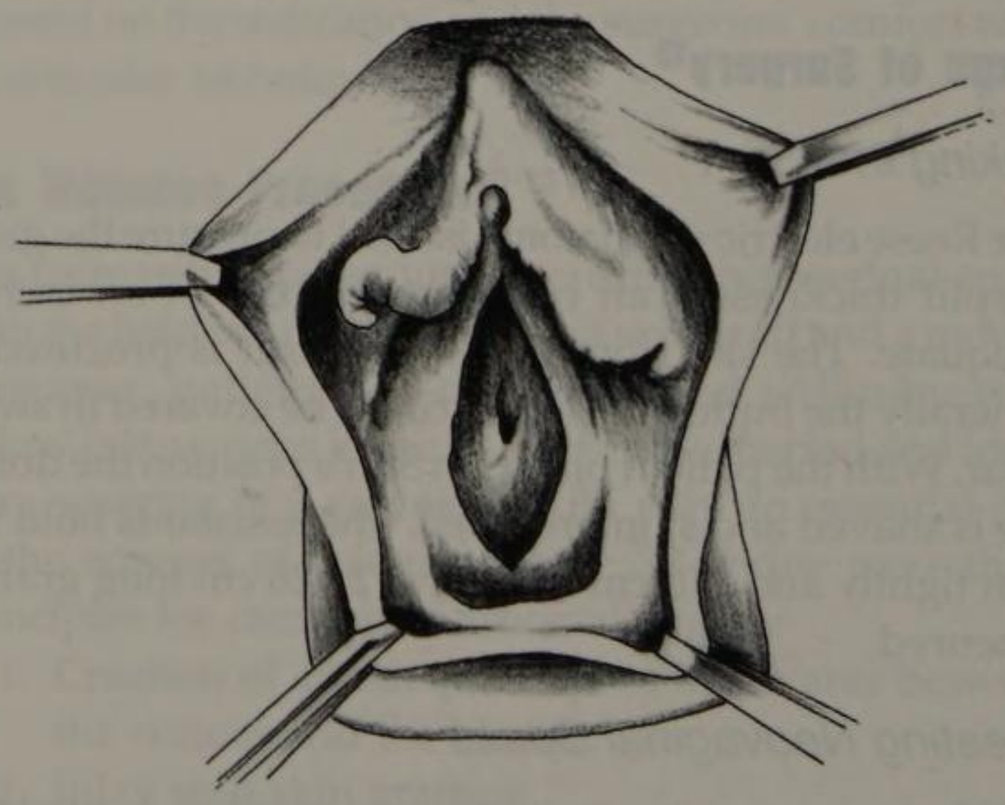

Fig. 35.2: Labia distracted laterally, no vagina present

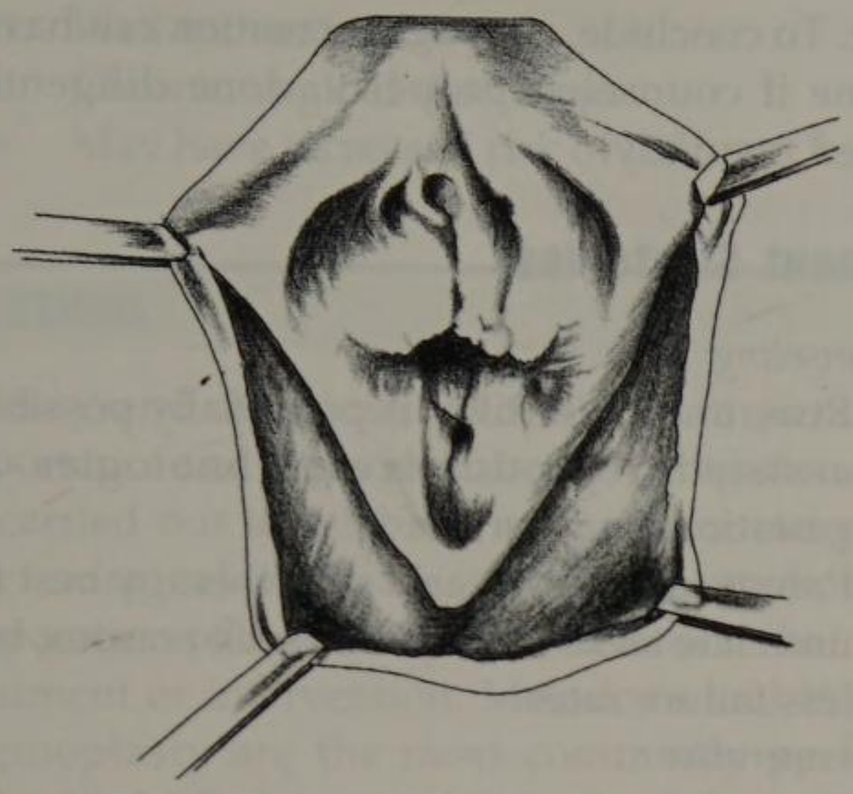

Fig. 35.3: Horse-shoe shaped incision deepened to expose superficial perineal muscles

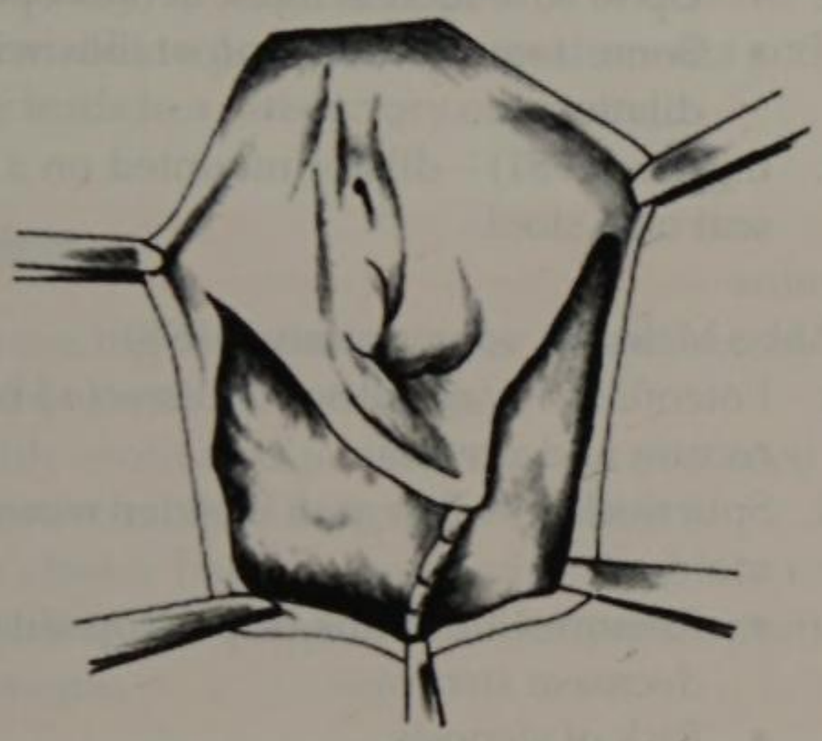

Fig. 35.4: Inner skin margins united progressively with fine sutures

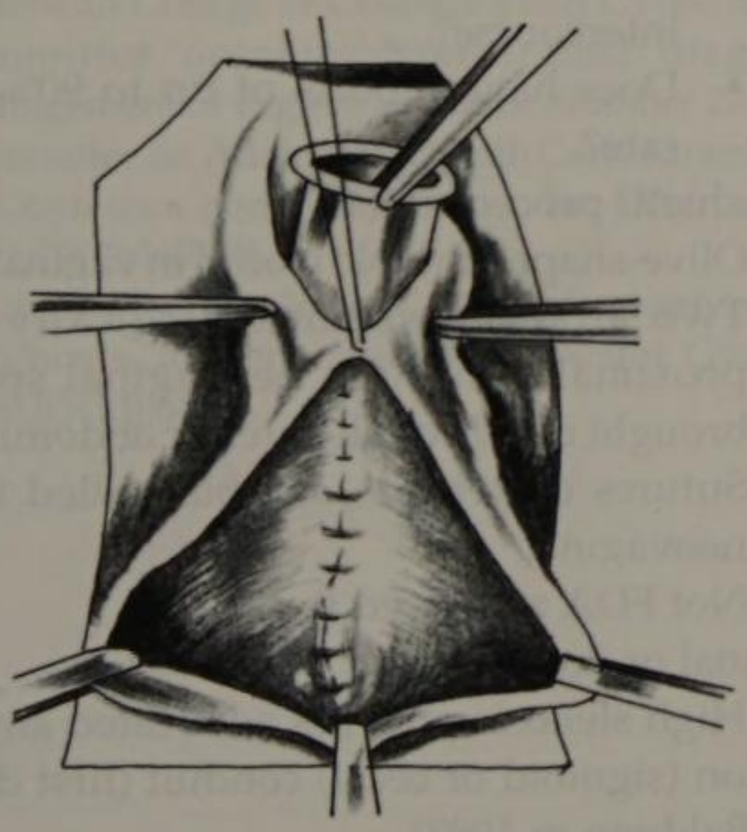

Fig. 35.5: Vaginal tube completed no. 6 dilator in situ

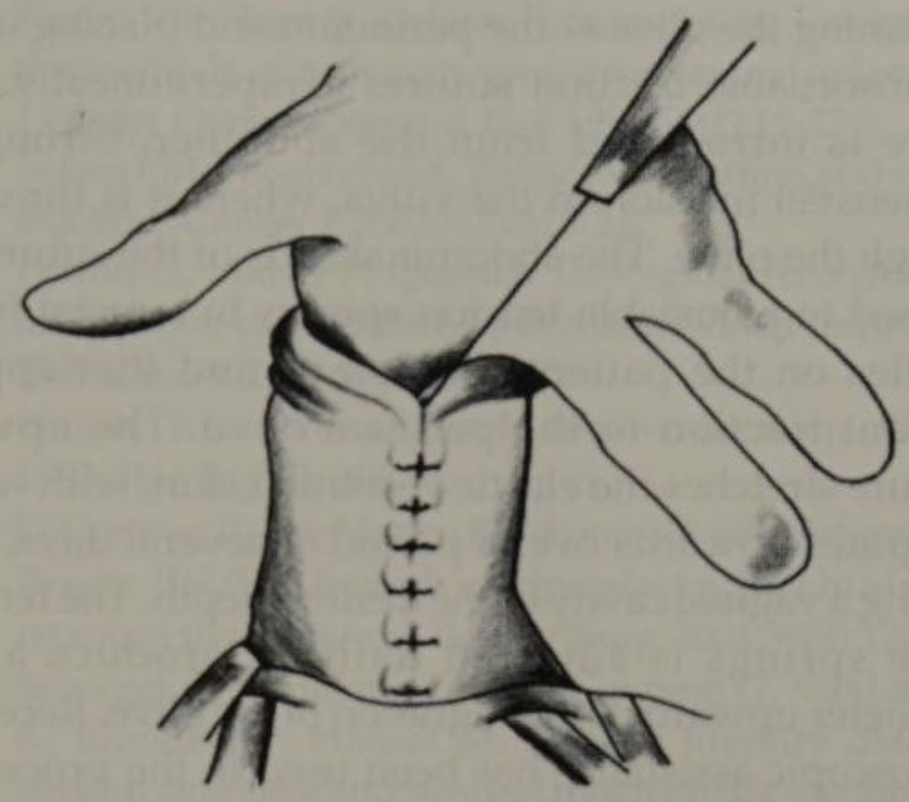

Fig. 35.6: Two fingers easily passed into new vagina

end at the horizontal level of clitoris and about 4 cm lateral to the urethra on both sides. The incision is deepened to the level of the superficial perineal muscles.

2. *Suturing the skin margins in two layers:*
   The inner skin margins are sutured from below upwards in interrupted fashion keeping the knots towards the inside. The superficial perineal muscles are sutured over the vaginal tube. This is an important step, as this would support the neovagina. The skin margin external to initial horse shoe incision is sutured in interrupted fashion with nylon sutures. A supported catheter is placed *in situ*.
3. *Assessment of cavity size:*
   The size of the cavity should be checked .It should allow two fingers and should be about 10 cm in length.
4. *Postoperative steps*:
   The skin sutures are removed in a week's time when the wound healing is adequate
   It takes about three weeks of twice daily dilatation to attain and maintain optimal introitus size.

The Vecchietti Operation[13,15,16]

The procedure was first described in 1969 by Giusippe Vecchietti. Later Veronikus and colleagues described a laparoscopic modification in the procedure. The procedure constructs a dilation type neovagina in seven to nine days. Specialized equipment including a traction device, a ligature carrier and an acrylic shaped olive are used. The process is in two steps, with an operative and postoperative component. The operative phase involves

positioning the olive at the perineum and placing of the non-absorbable traction sutures exraperitoneally. The suture is introduced from the abdomen through a Pfannenstiel incision to the vulva, where it is threaded through the olive. The abdominal ends of the suture are attached to adjustable tension springs in a metal frame that lies on the patient's abdomen and that applies constant traction to the perineal olive. The upward pressure stretches the elastic vestibular skin, with which it migrates upwards over a period of several days, thus creating a vaginal cavity of the desired depth. The tension of the springs is adjusted daily to produce a one centimeter upward daily migration of the olive. Recently, laparoscopic assistance has been used in the procedure (using three ports, one to either sides of the rectus muscles and the third subumblical) to save the patients from the discomfort and disfigurement of a laparotomy.

Bowel Vaginoplasty[7,13]

Many surgeons have used parts of large intestine like caecum and sigmoid colon to create a neovagina. The advantage claimed is the lesser incidence of scar formation and no chances of rejection (as it is autograft) and good vascular uptake. But the procedure requires laparotomy and manipulation of a normal and very essential organ structure (the large intestine) which is a major deterrent in presence of less extensive procedures with good results. Ota has described a laparoscopic modification.

In conclusion, surgical creation of a new vagina is a surgery requiring detailed pre operative counseling, postoperative compliance and regular follow-up. Patients who are not enough motivated or have unrealistically high expectations can be very difficult to manage and may not be offered surgery. McIndoe and William's method are the most commonly used methods, and the laparoscopic surgical options are gaining rapid strides. The surgeon should use the technique best suited for the patient and the results are fair in most cases. There are future trends with evolving laparoscopic techniques, which can make the surgery much more patient friendly. The use of better tissue biomaterial in future will improve the picture further. The most important steps in the effective management of vaginal agenesis are correct diagnosis of the underlying condition, evaluation for associated congenital, renal or other anomalies and careful psychological preparation of the patient before any treatment or intervention. It should be clear to the surgeon that it is not the surgery only which matters, but also the mental makeup and the expectations of the patient. To conclude, neovagina creation can have good outcome if counseled properly, done diligently and followed regularly.

Treatment Strategies

1. *Counseling*
   a. Reassurance (fertility is potentially possible with assisted reproductive technologies and a gestational carrier).
   b. Parents may seek early surg therapy best to wait until late teens mainly for psych reasons, but also less failure rates.
2. *Non-operative*
   a. Progressive invagination of vaginal dimple
      i. Frank (1938) – gradual glass dilators over 6 months – 2 years
         - Up to 90% success rates, avoids operation.
         - Some females uncomfortable with self dilating.
      ii. Ingram (1981) – dilator mounted on a bicycle seat on a stool.
3. *Operative*
   a. Abbe-McIndoe vaginoplasty (1898)
      i. Potential neovaginal space dissected between rectum and urethra.
      ii. Split thickness skin graft inserted mounted on mold
         - Requires 3 months of post op dilation to decrease stenosis.
         - Risk of stenosis.
   b. William vulvovaginoplasty
      i. Full thickness skin graft from labia
         - Can create an awkward angle for intercourse?
         - Does have reports of up to 90% success rate?
   c. Vecchietti procedure (1979)
      i. Olive-shaped marble placed in vaginal dimple.
      ii. Two attached sutures surgically guided proximally through neovaginal space and brought out through anterior abdominal wall.
      iii. Sutures on tension, marble pulled to create neovagina.
      iv. Not FDA approved in USA.
   d. Jejunal or ileal conduit
      i. High stenosis rate, not advocated anymore.
   e. Colon (sigmoid or cecal) conduit (first described by Baldwin in 1907).
      i. No dilators needed.

ii. Well lubricated.
iii. Chronic vaginal discharge.
iv. May have increased risk of HIV and hepatitis.

CONCLUSIONS

1. History and diagnostic workup is of paramount importance and every indicated investigation should be carried out to establish a diagnosis and prevent any surgical mishap. Careful psychological preparation of the patient should be done before any treatment or intervention. McIndoe's and William's vaginoplasty are the most commonly performed procedures. Laparoscopic approach has also been gaining importance with satisfactory postoperative results.

Eventually, a surgical approach which the surgeon is comfortable to perform, has good results and patient friendly leads to a satisfactory outcome.

Key Points

1. Counseling and reassurance of patient and her parents about the condition.
2. Highly motivated patients may be provided non-operative method as first line treatment.
3. The choice between surgeries depends on the indication and surgeon's comfort with a particular technique.

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36 Excision of Transverse and Longitudinal Vaginal Septum

Sumita Mehta

INTRODUCTION

Mullerian anomalies represent a vast array of structural abnormalities resulting from the improper development and fusion of the embryological Mullerian ducts. The precise incidence of these anomalies is unclear but is generally considered to be between 1% and 3%. [1] There are two kinds of vaginal septa resulting from either vertical fusion defects (transverse vaginal septum) or lateral fusion disorders (longitudinal vaginal septum).

Transverse Vaginal Septum

Pathophysiology

Vertical fusion defects may result from failure of fusion of the mullerian system with urogenital sinus or may be due to incomplete canalization of the vagina.[2] The incidence varies from 1 in 2000 to 1 in 72,000.[3] It can be located at almost any level in the vagina, namely high, middle and low and the incidence is reported as 46%, 35% and 19% respectively.[4,5] The septae can be thick or thin but experience is required to make this initial judgment. In general, the thicker septum is commonly closer to the cervix.[4] In contrast to congenital absence of the mullerian ducts, vaginal septum is associated with few urologic or other anomalies.[6]

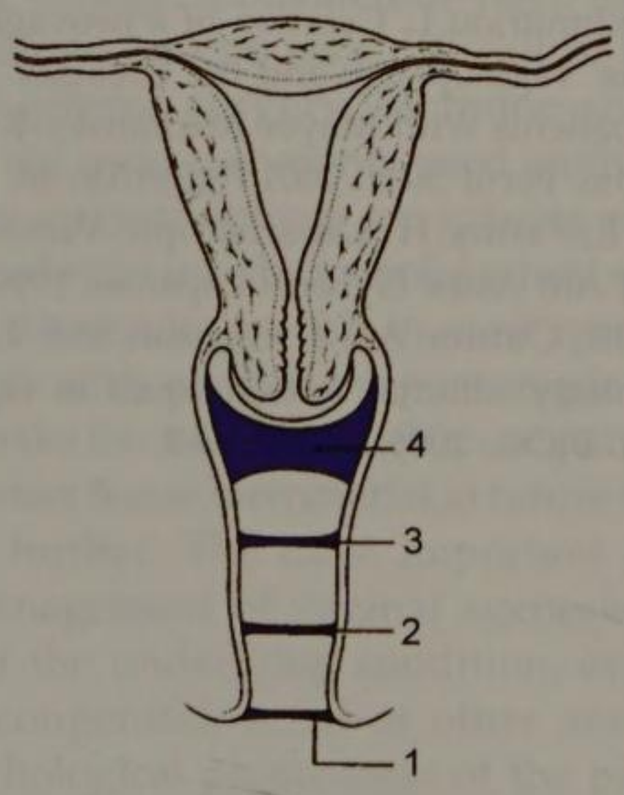

Fig. 36.1: Disorders of vertical fusion

Symptomatology

The transverse vaginal septum prevents escape of menstrual blood so cryptomenorrhea results. Patients present with cyclical abdominal pain and a hematocolpos may be palpable within the pelvis. The distended upper vagina creates a large pelvic and lower abdominal mass that can displace the bladder anteriorly, displace the ureters laterally with hydroureter and hydronephrosis and compress the rectum with associated constipation.[7]

Preoperative Investigations

1. Thorough history and careful examination.
2. Ultrasonography will help to detect hematocolpos or hematometra. The level of septal defect can also be assessed. Any associated urological defects should also be looked for.[8]
3. 3-D ultrasonographically reconstructed images facilitate better understanding of the anatomic relationships.
4. Hysterosalpingography can help to delineate any associated uterine malformation.
5. MRI can sometimes be used in cases of high vaginal septum.[9]

Excision of Transverse Vaginal Septum

Surgical Steps

1. A transverse incision is made through the vault of the short vagina (Fig. 36.2).
2. Areolar tissue is dissected in the space between the vagina and rectum (Fig. 36.3).
3. Palpation of a urethral catheter anteriorly and insertion of a finger along the anterior wall of rectum posteriorly provides the surgical guidance for proper dissection planes so that injury to bladder and rectum can be avoided.
4. After the dissection is continued for a short distance, the cervix can be palpated and continuity can be established with the upper segment of the vagina.
5. The lateral margins of the excised septum are extended widely by sharp dissection (to avoid postoperative stricture formation).
6. The edges of the upper and the lower vaginal mucosa are undermined and mobilized enough to permit anastomosis using interrupted delayed absorbable sutures (Fig. 36.4).
7. After the completed anastomosis, the vagina formed is of normal caliber but of slightly shorter length than normal (Fig. 36.5).

Excision of High Transverse Vaginal Septum

In these cases, the length of the obstructing transverse vaginal septum is such that re-anastomosis of upper and lower atretic vagina is difficult.

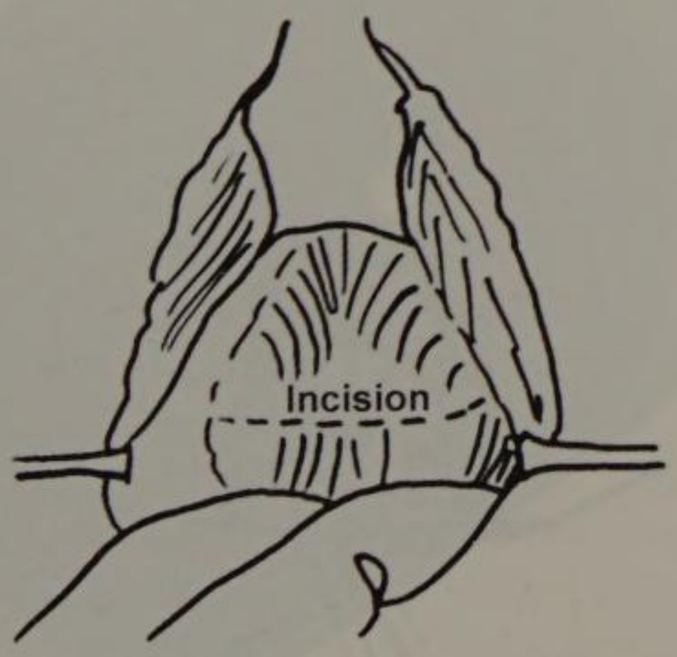

Fig. 36.2: The line of incision is drawn through the vaginal mucosa

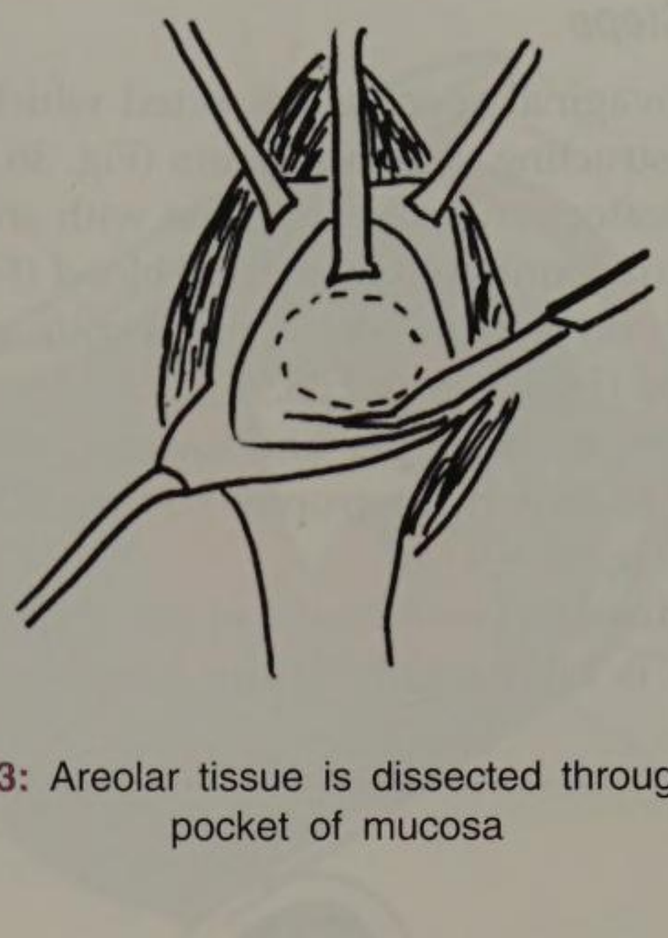

Fig. 36.3: Areolar tissue is dissected through to the pocket of mucosa

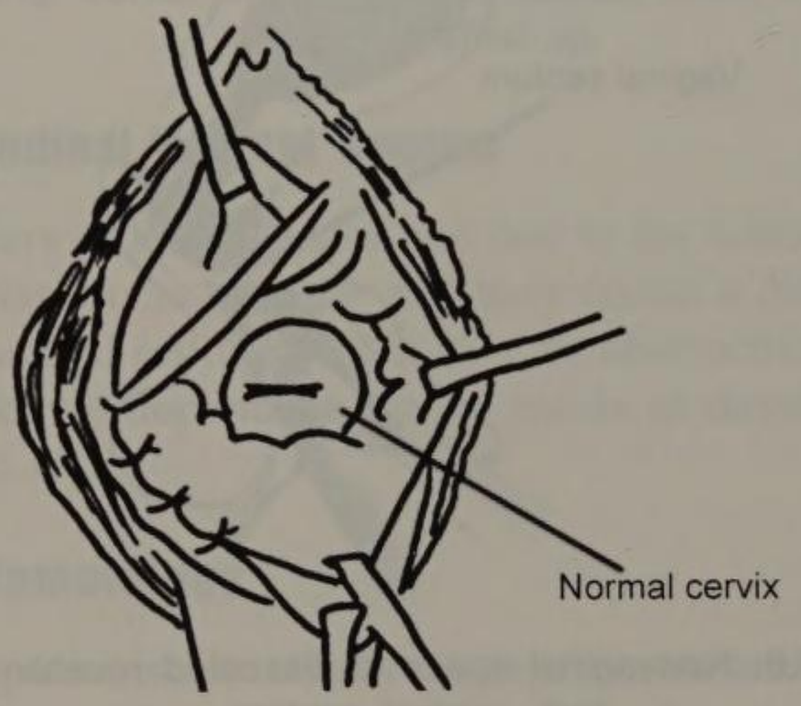

Fig. 36.4: An anastomosis is made between the lower vagina and the upper vagina

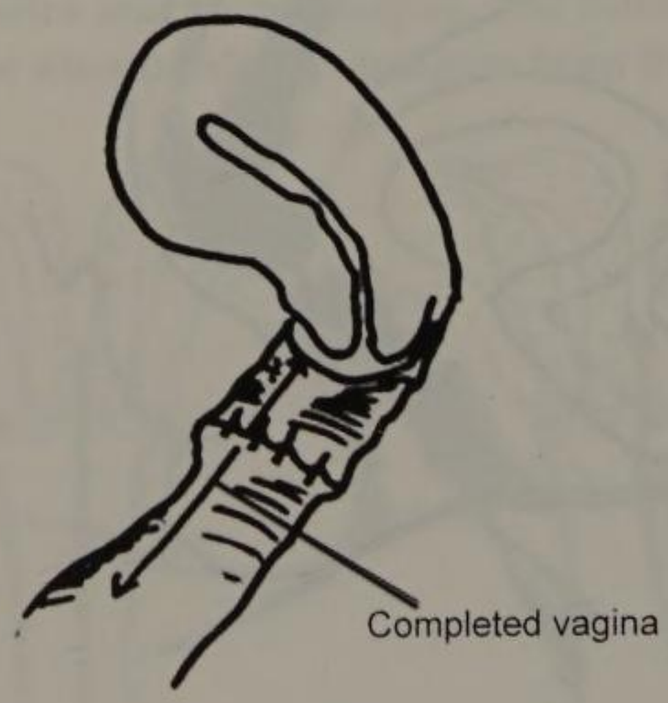

Fig. 36.5: Completed vagina of normal caliber but shorter length than normal

Surgical Steps

1. The neovaginal space is dissected which reveals a high obstructing vaginal septum (Fig. 36.6).
2. The operator can probe the mass with an aspirating needle to identify old menstrual blood (Fig. 36.7).
3. The incision is made with a sharp knife and septum is excised (Figs 36.8 and 36.9).
4. The edges of the upper and lower vaginal mucosa are over sewn with interrupted sutures of 2-0 chromic catgut (Fig. 36.10).
5. As the distance between the upper vaginal area and septum is too great to allow anastomosis a split

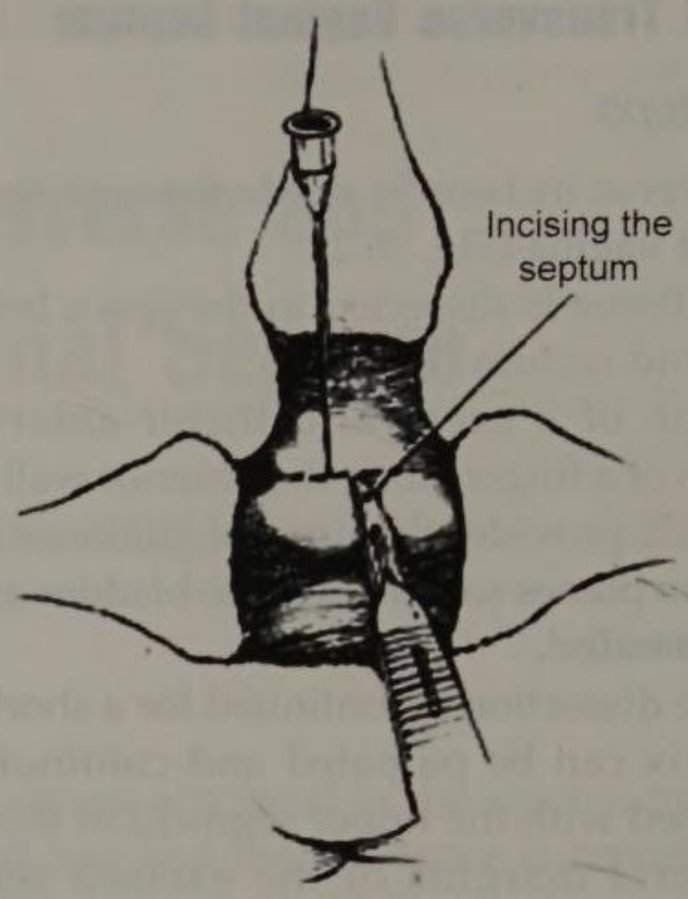

Fig. 36.8: Incision made over the septum

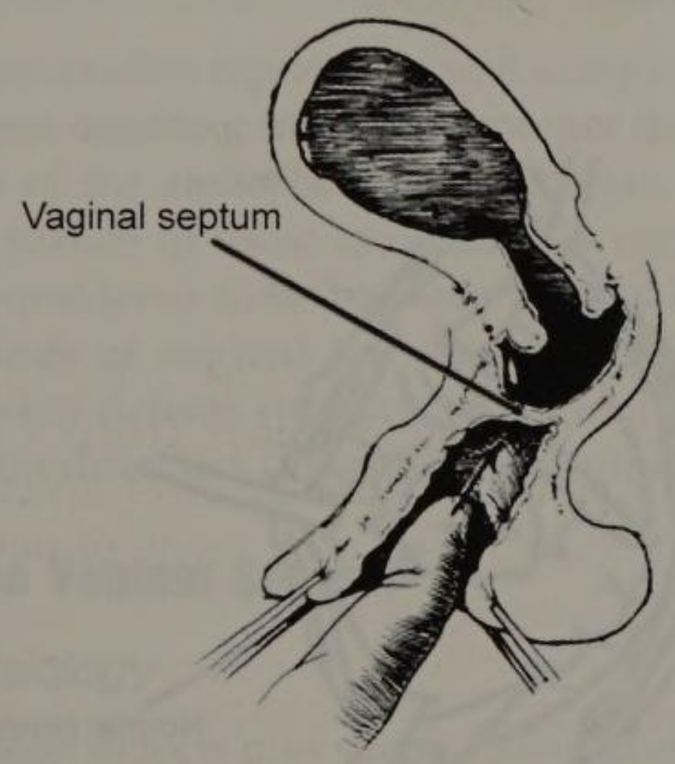

Fig. 36.6: Neovaginal space is dissected revealing the high vaginal septum

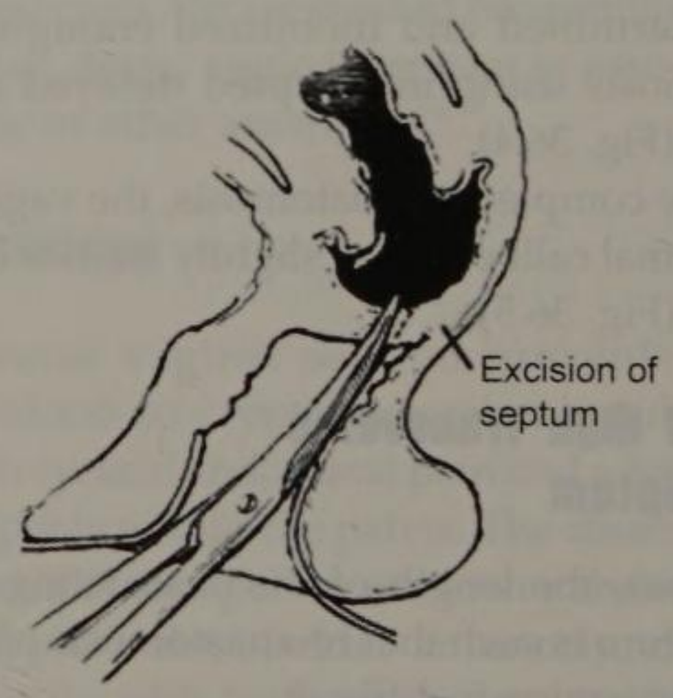

Fig. 36.9: Septum is excised

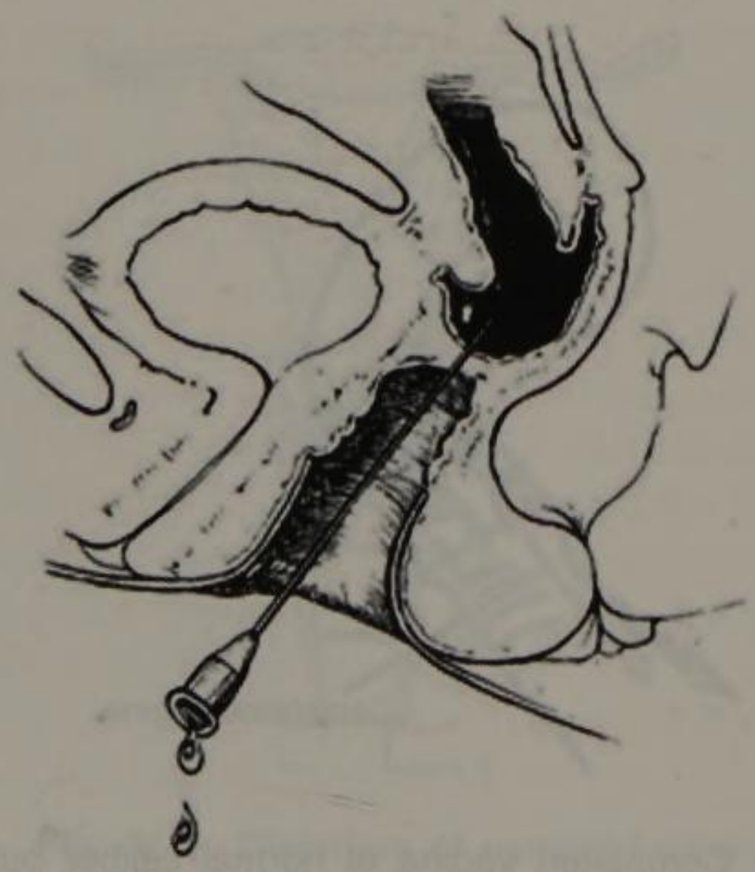

Fig. 36.7: A needle is placed through the septum

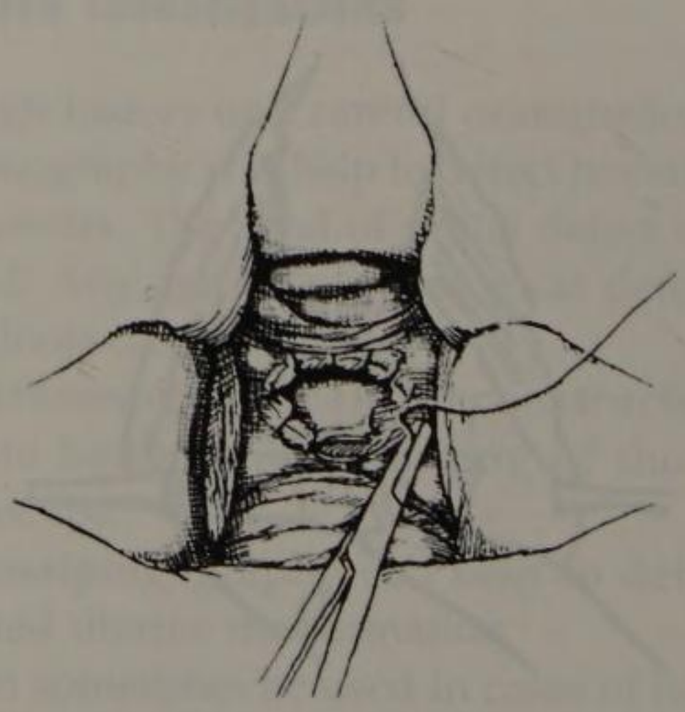

Fig. 36.10: The wall of the septum is oversewn with interrupted sutures

thickness skin graft can be sutured in situ so that the vaginal epithelization can occur.

Z-Plasty

This procedure was described by Garcia in 1967.[10] It is preferable in cases of high vaginal septum to prevent postoperative vaginal stenosis and shortening. [11,12]

Surgical Steps

1. The thick septum is perforated centrally and the upper and lower layers are separated.
2. Four radial incisions are made in the lower flap at 0°, 90°, 180° and 270° and four in the upper flap at 45°, 135°, 225° and 315° (Fig. 36.11).
3. The upper tags are then transposed down and the lower flaps are lifted up thus lining in the wall of vagina with a circular saw-shaped suture line (Fig. 36.12).

Complications

1. Damage to bladder/rectum.
2. Hemorrhage especially in cases of thick septum.
3. Vaginal stenosis or constriction at the site of septal excision and "hour glass" vagina.
4. Dyspareunia.
5. Failure of pregnancy.

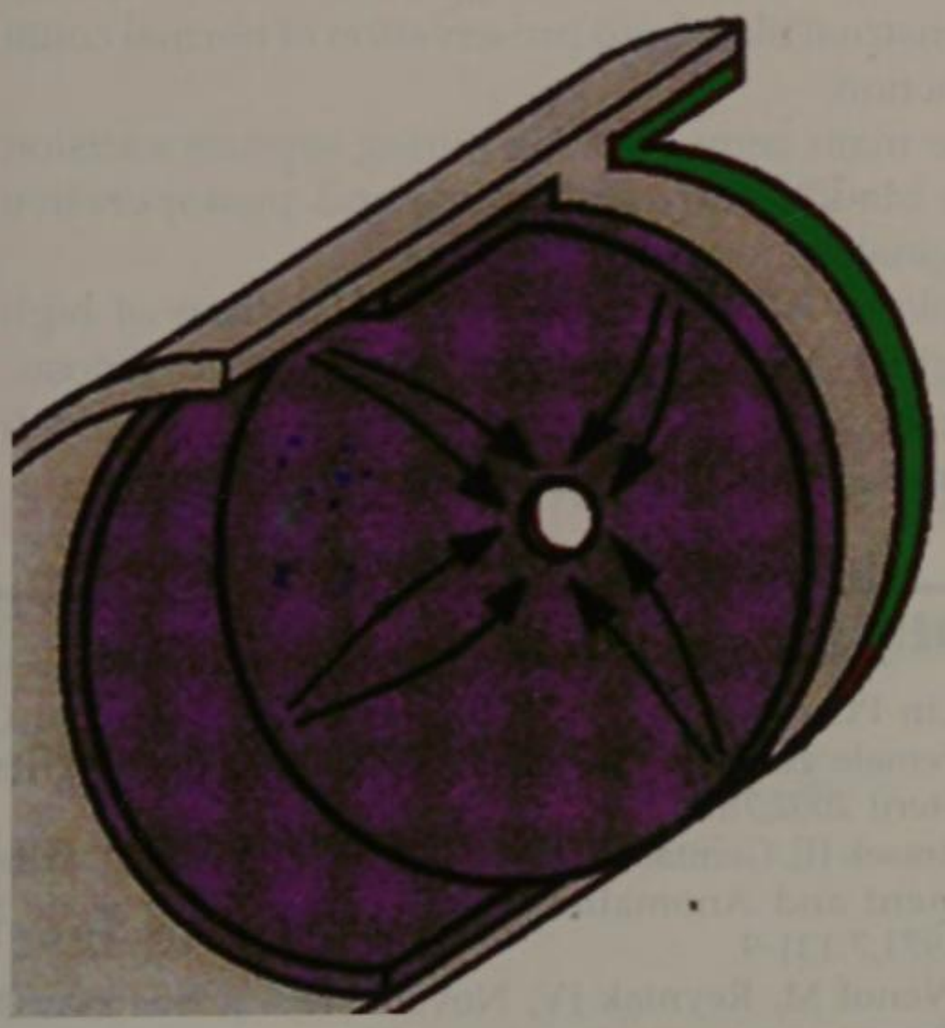

Fig. 36.11: The lines of incision

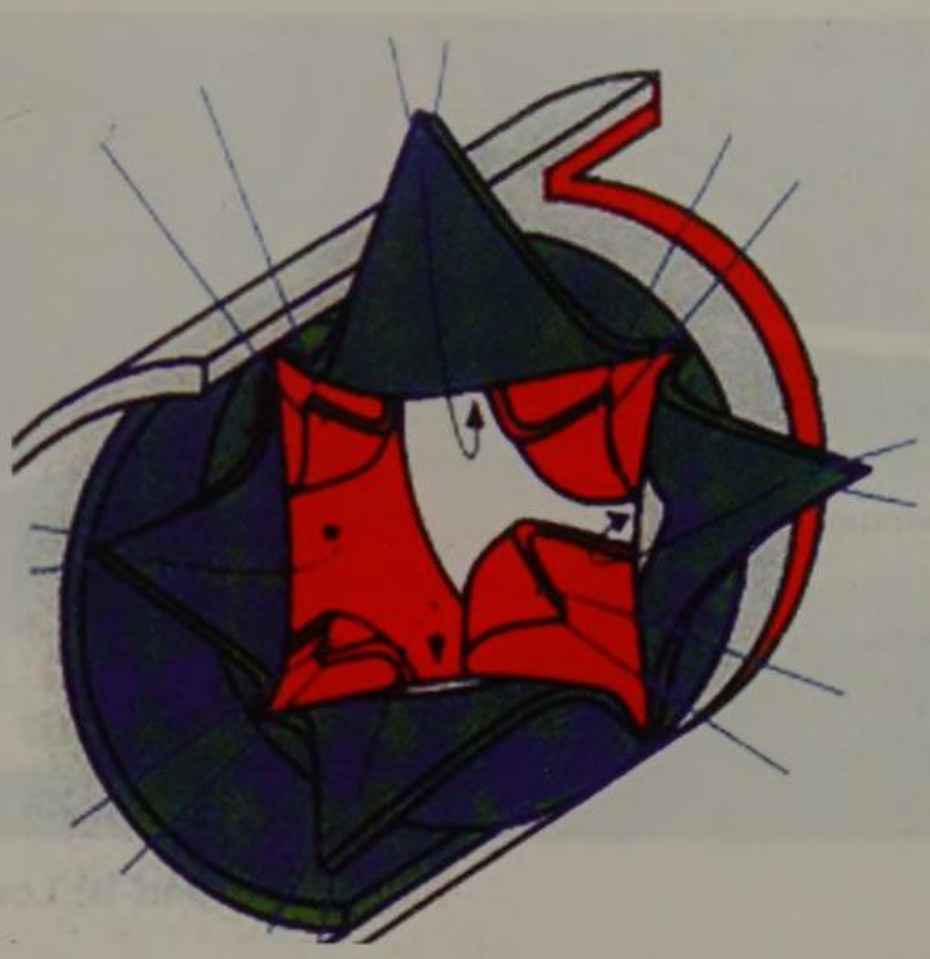

Fig. 36.12: Upper tags transposed down and lower flap lifted up

Longitudinal Vaginal Septum

Disorders of lateral fusion are due to the failure of the mullerian ducts to unite and may create a duplicated uterovaginal septum which may be obstructive or non obstructive, depending on the mode of development (Fig. 36.13).

Symptomatology

These patients are mostly asymptomatic and present with the incidental finding of a vaginal septum. Some patients can present with dyspareunia. If there is unilateral vaginal obstruction, then the patient presents with abdominal pain and associated symptoms of hematometra and hematocolpos. The confusing clinical sign is the associated menstruation from the other side.

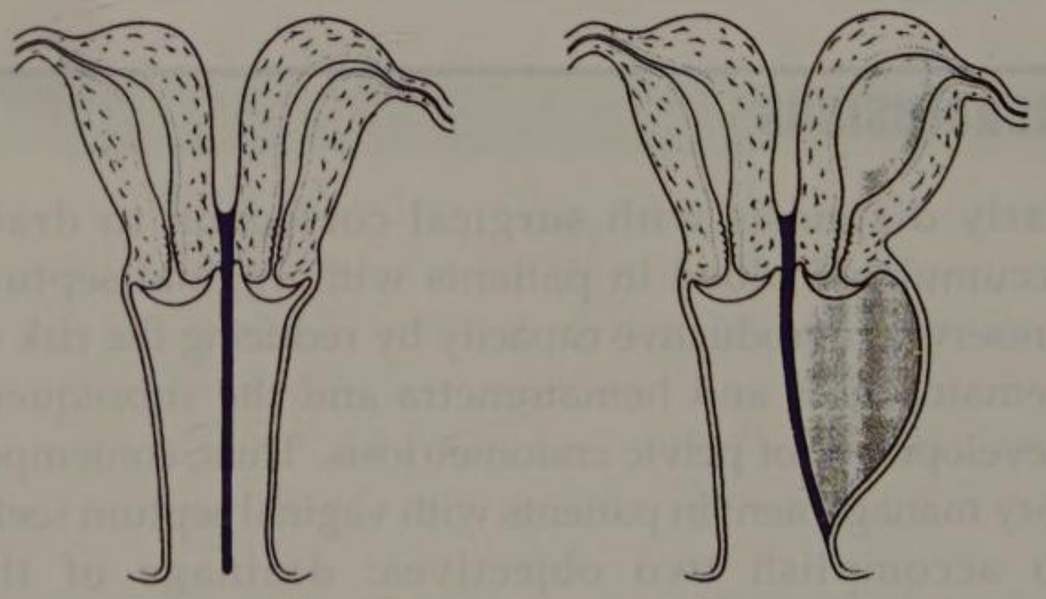

Fig. 36.13: Disorders of lateral fusion

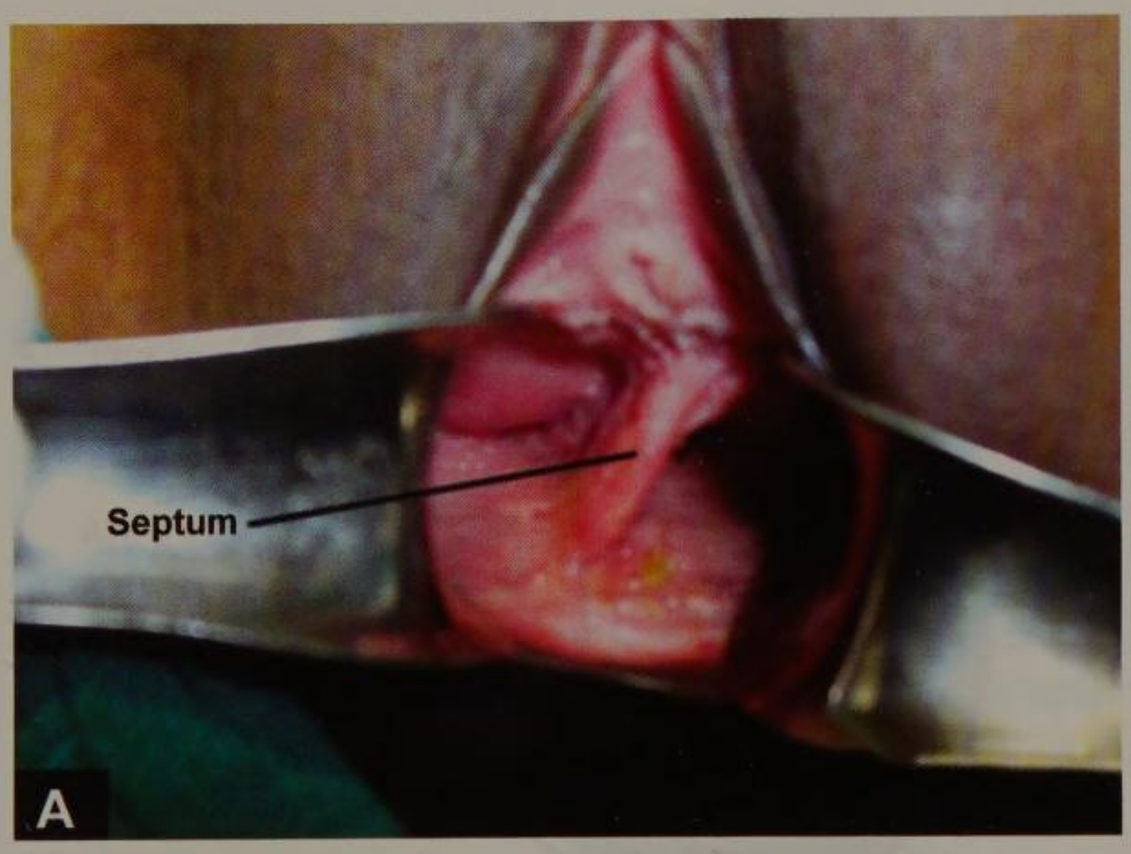

Fig. 36.14A and B: Lower end of septum seen at introitus

Excision of Longitudinal Septum

Surgical Steps

1. Septum is held with clamp and gentle traction is applied. Excess traction is avoided as this can draw the urethra, bladder or rectum into the area of excision (Figs 36.14A and B).
2. The septum is incised at its inferior and superior attachments from the posterior and anterior vaginal walls respectively.
3. The defect is repaired using interrupted absorbable sutures.

Complications

1. Damage to bladder/rectum.
2. Hemorrhage especially in cases of thick vaginal septum.
3. Vaginal stenosis or constriction at the site of septal excision.

CONCLUSIONS

Early diagnosis with surgical correction to drain accumulated blood in patients with vaginal septum preserves reproductive capacity by reducing the risk of hematocolpos and hematometra and the subsequent development of pelvic endometriosis. Thus, contemporary management in patients with vaginal septum seeks to accomplish two objectives: drainage of the accumulated blood and preservation of adequate vaginal length.

Key Points

1. The incidence of Mullerian duct anomalies varies between 1% and 3%.
2. Transverse vaginal septum can occur at various levels, namely high, mid and low and its incidence is variously reported as 46%, 35% and 19% respectively.
3. Patients with vaginal septum commonly present with cyclical abdominal pain, cryptomenorrhea and pelvic/lower abdominal mass.
4. Contemporary management seeks to accomplish the objectives of drainage of the accumulated menstrual blood and preservation of normal coital function.
5. The main complications during septum excision are bladder or rectal injury and postoperative vaginal stenosis or shortening.
6. Z-plasty technique can be used in cases of high vaginal septum to prevent post operative stenosis.
7. The results of surgery are extremely good for both transverse and longitudinal vaginal septum.

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37 Fallopian Tube Prolapse and Tubal Ligation

Shalini Rajaram, Namita Grover

INTRODUCTION

Prolapse of the fallopian tube is a rare complication of gynecologic surgery. Various factors contributing to postoperative fallopian tube prolapse are:[1-3]

1. Pelvic infection
2. Hematoma
3. Intraperitoneal vaginal packs
4. Failure to close vaginal cuff
5. Failure of retroperitonization
6. T-tube suction drain exiting the vaginal cuff (pressure necrosis of the overlying peritoneum or laceration of the peritoneum at the time of its removal may lead to fallopian tube prolapse)

Fallopian tube prolapse requires coexistence of three conditions:

1. Fallopian tube segment of sufficient length and mobility so as to reach the vagina
2. Defect in the peritoneal closure
3. Adequate opening within the vaginal cuff.

Surgical Correction of Fallopian Tube Prolapse[4]

The prolapsed fallopian tube usually presents as red 'granulation' tissue in the apex of the vagina (Fig. 37.1). Surgical excision is done by placing Allis clamps just below the lateral angles of the cuff and making a horizontal incision posterior to the prolapsed tube and vaginal scar (Fig. 37.2). Allis clamps are reapplied to the edges of the incision and the peritoneum is visualized. Sharp and blunt dissection may be necessary to identify the peritoneum (Fig. 37.3). The peritoneum is then elevated and after ensuring that no vital structure has been grasped, the peritoneum is incised (Fig. 37.4). The peritoneal incision is extended horizontally so as to

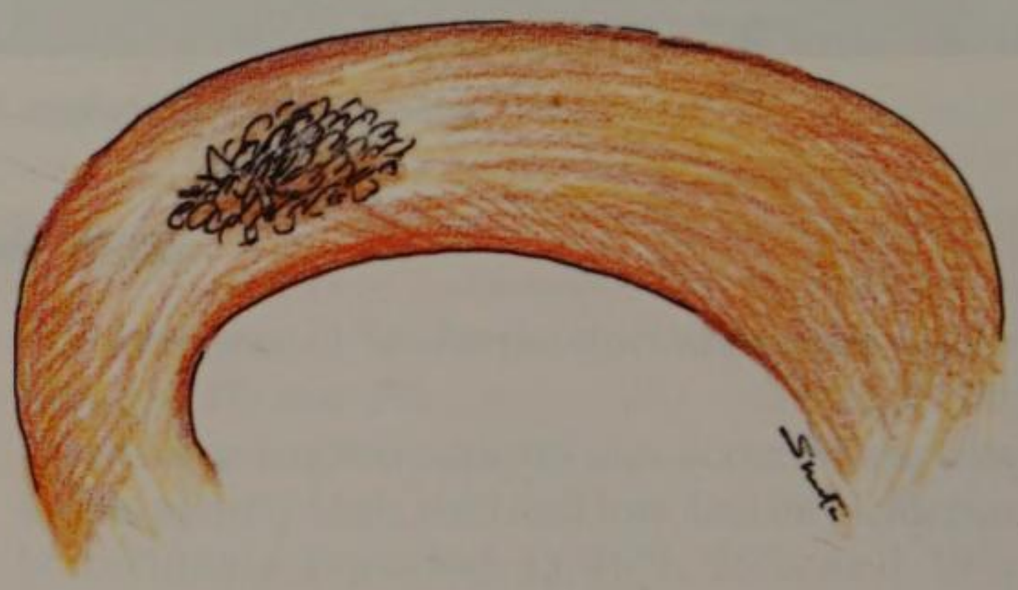

Fig. 37.1: Fimbrial end prolapsing at vault

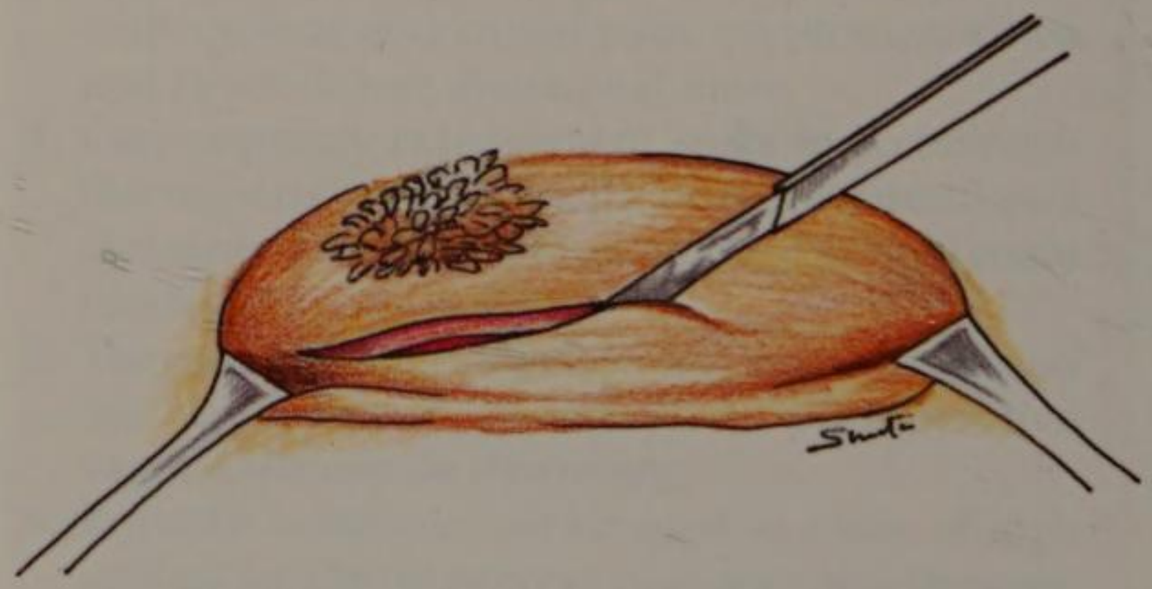

Fig. 37.2: Incision given on vaginal vault away from prolapsed fallopian tube

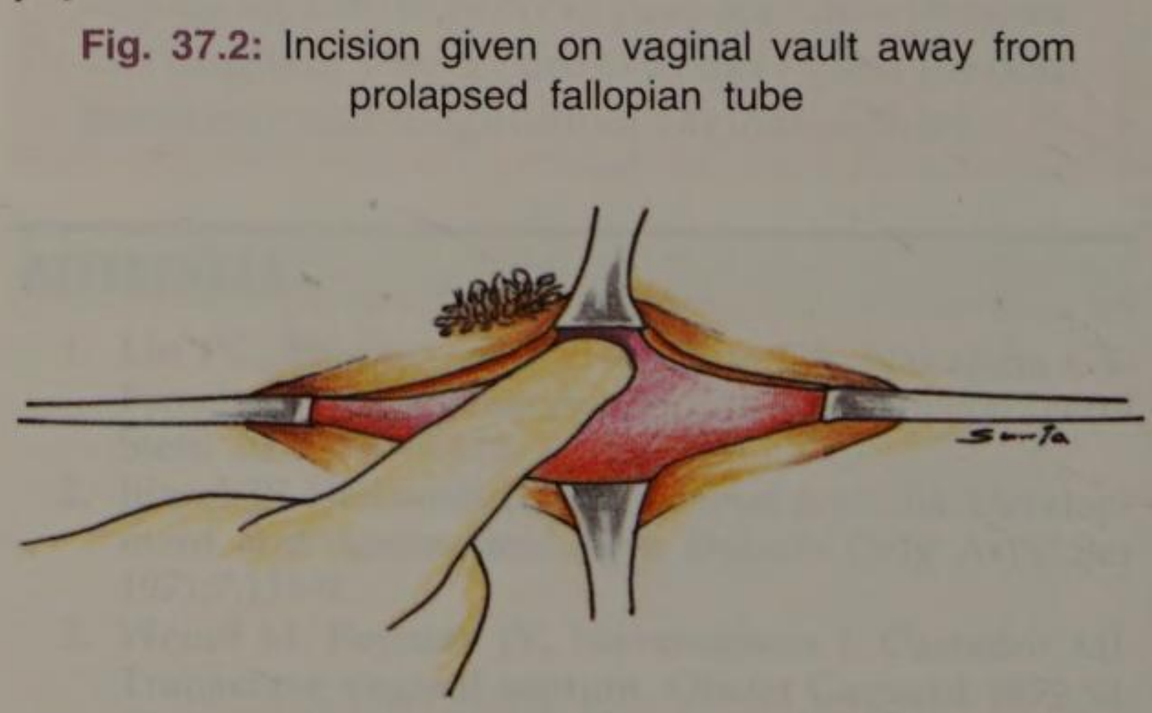

Fig. 37.3: Vaginal wall being separated from peritoneum

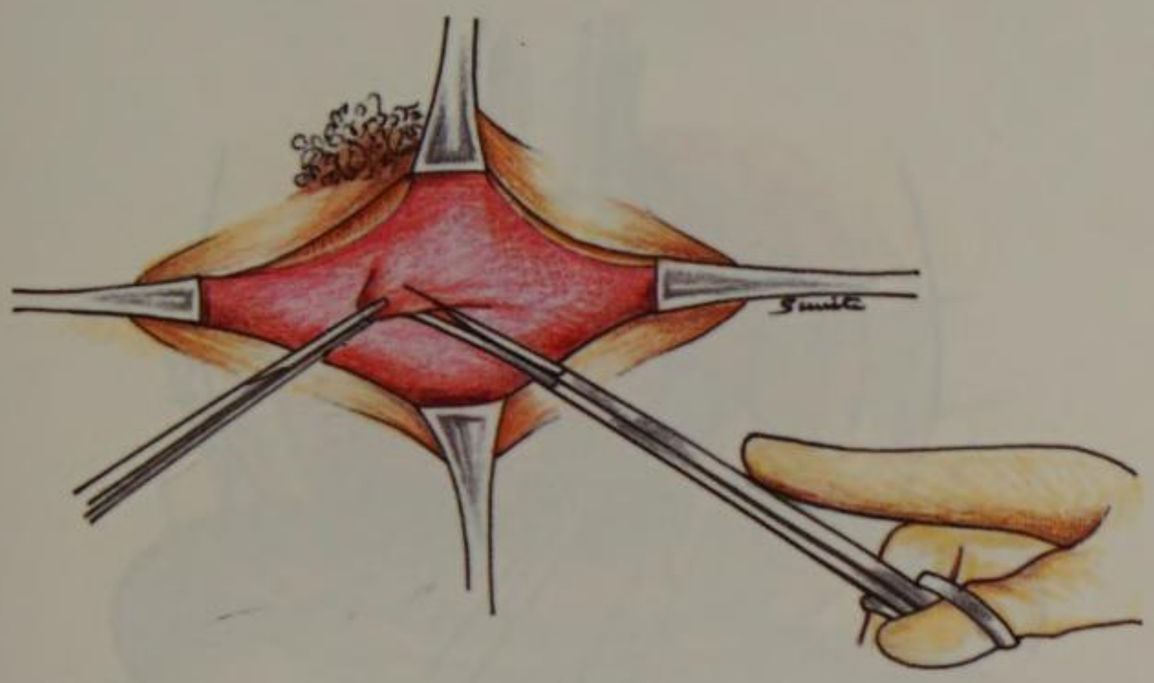

Fig. 37.4: Peritoneum incised with scissors

visualize the ovary and other intraperitoneal structures. Periovarian and peritubular adhesions are freed by sharp and blunt dissection (Fig. 37.5). By inspection and palpation, it is ascertained that there are no further adhesions to the tube and vaginal cuff. The vagina is incised horizontally anterior to the prolapsed fallopian tube and vaginal cuff, so as to remove a portion of the vagina all around the prolapsed tube. An intraperitoneal finger can protect vital structures. A long-weighted speculum is inserted posteriorly, and retractors are used to assure good exposure. A salpingectomy is then performed by clamping and cutting the mesosalpinx. All pedicles are sutured with 2-0 absorbable suture. The entire tube with an attached collar of vagina is removed (Fig. 37.6). After hemostasis has been assured, the peritoneum is closed with a running 2-0 absorbable suture. The vaginal cuff is closed separately with interrupted 0 absorbable sutures (Fig. 37.7).

Caution: Careful entry into peritoneal cavity is made at a distance from the actual site of prolapse so as to avoid intraperitoneal adhesions.

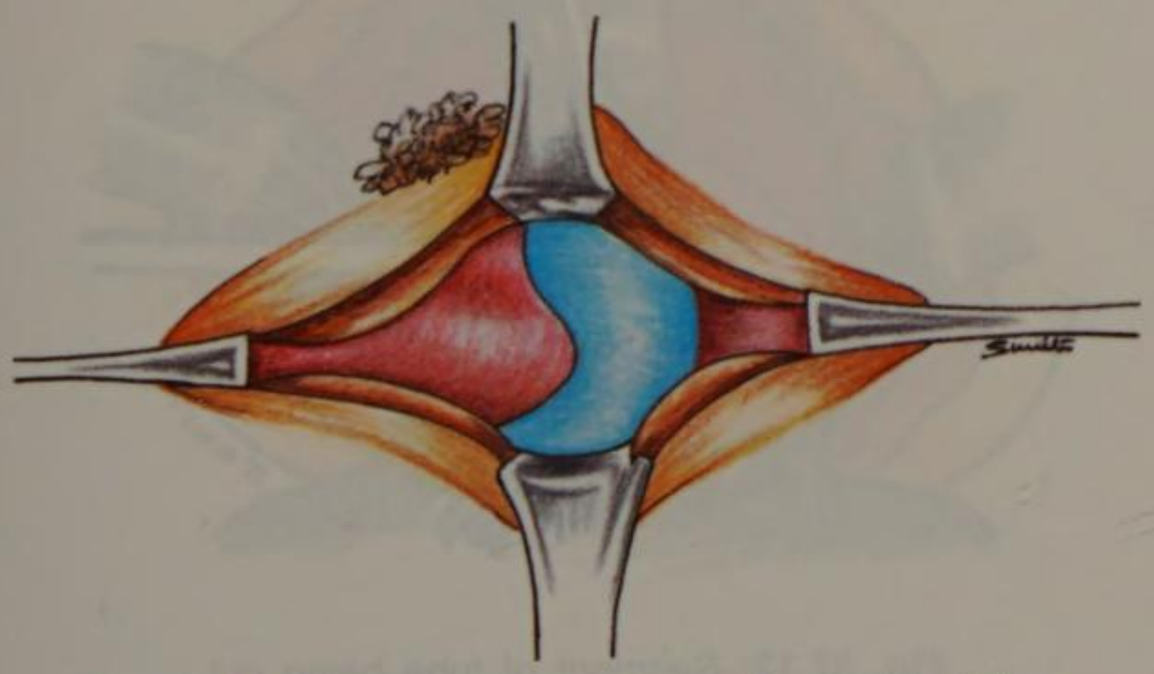

Fig. 37.5: Peritoneal cavity entered, ovaries, tubes inspected and dissected free

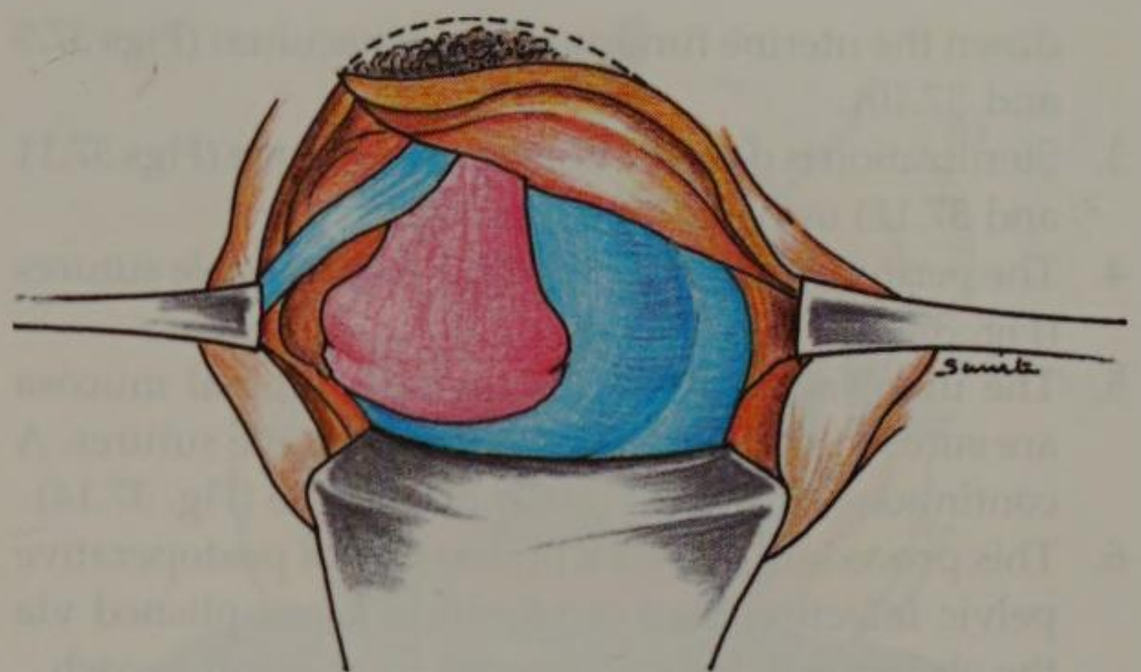

Fig. 37.6: Vagina is incised anterior to tube so that portion of vagina is removed with tube

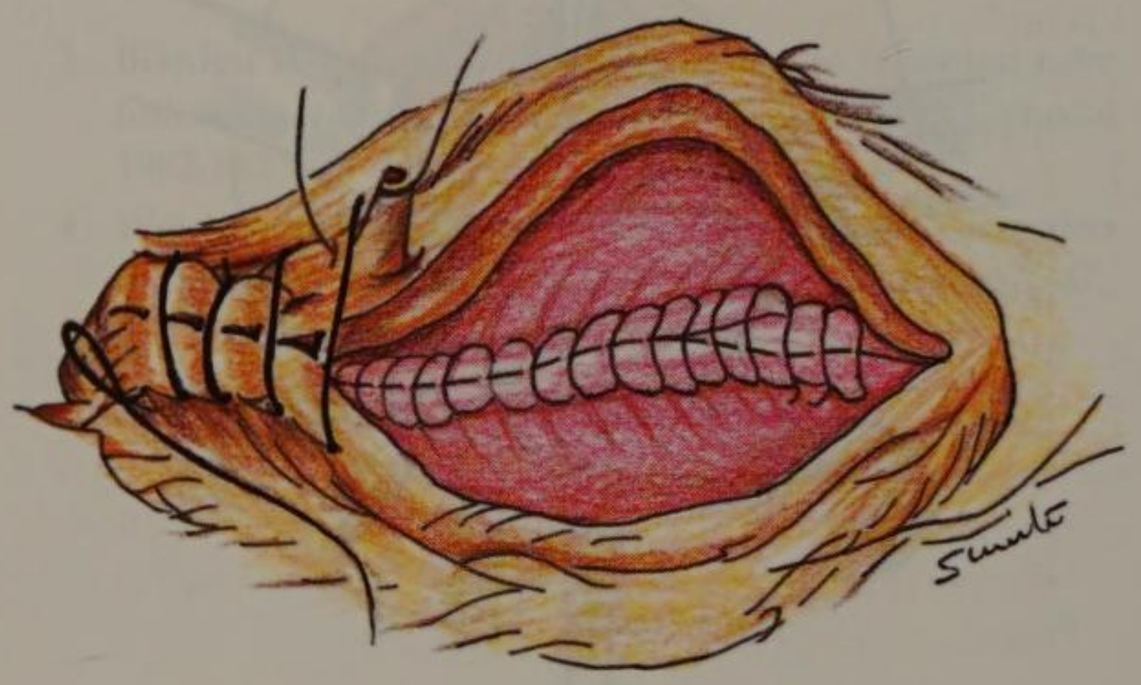

Fig. 37.7: Peritoneum and vagina closed with running suture

Tubal Ligation: Vaginal Route

1. The first part of the operation consists of the posterior colpotomy. The posterior lip of the cervix is elevated with a tenaculum and a transverse incision is made through the vaginal mucosa from one uterosacral ligament to the other (Fig. 37.8). If the peritoneum was not included in the original incision, it is opened next. The peritoneal opening is stretched between two index fingers. Adequate exposure with long, narrow retractors and deep Trendelenburg position are essential.
2. The tenaculum on the cervix has been removed and the cervix is tucked well into anterior fornix under a retractor blade. The uterine corpus is deflected to one and then the other side in order to bring the tubes into view. The tube is brought out with a Babcock clamp. The tube can also be exposed by drawing

down the uterine fundus with a tenaculum (Figs 37.9 and 37.10).

3. Sterilization is done by Pomeroy technique (Figs 37.11 and 37.12) using O chromic catgut.
4. The peritoneum is closed with 2-0 absorbable sutures (Fig. 37.13).
5. The uterosacral ligaments and the vaginal mucosa are sutured with interrupted 0 absorbable sutures. A continuous suture is equally acceptable (Fig. 37.14).
6. This procedure carries a higher risk of postoperative pelvic infection than sterilization accomplished via the abdominal, laparoscopic or mini-lap approach.

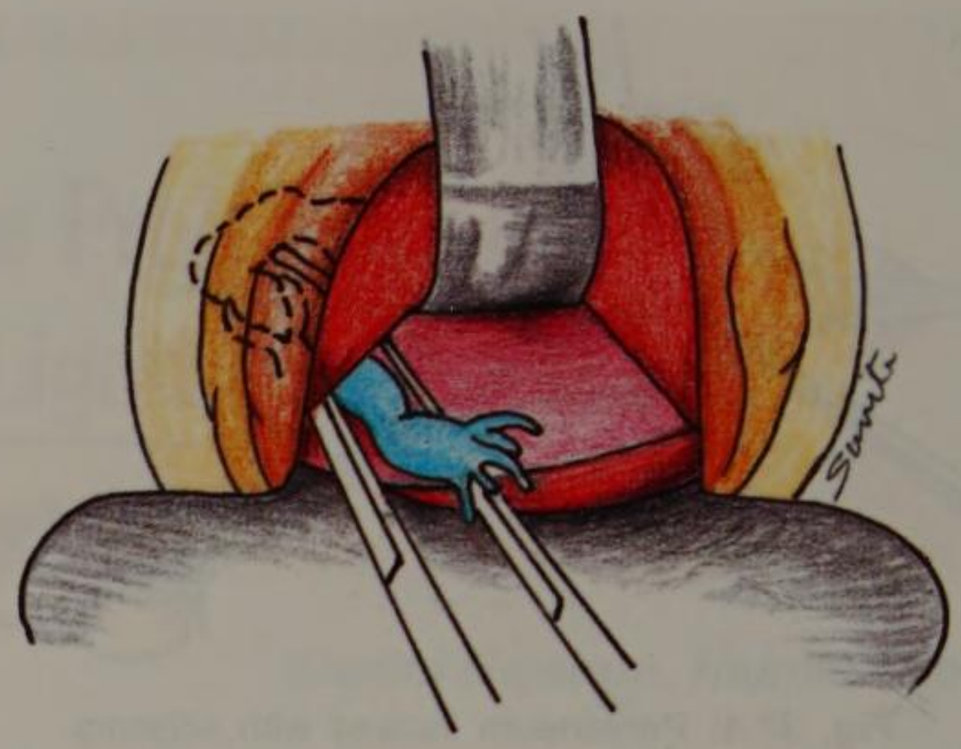

Fig. 37.10: Tube grasped with Babcock's forceps

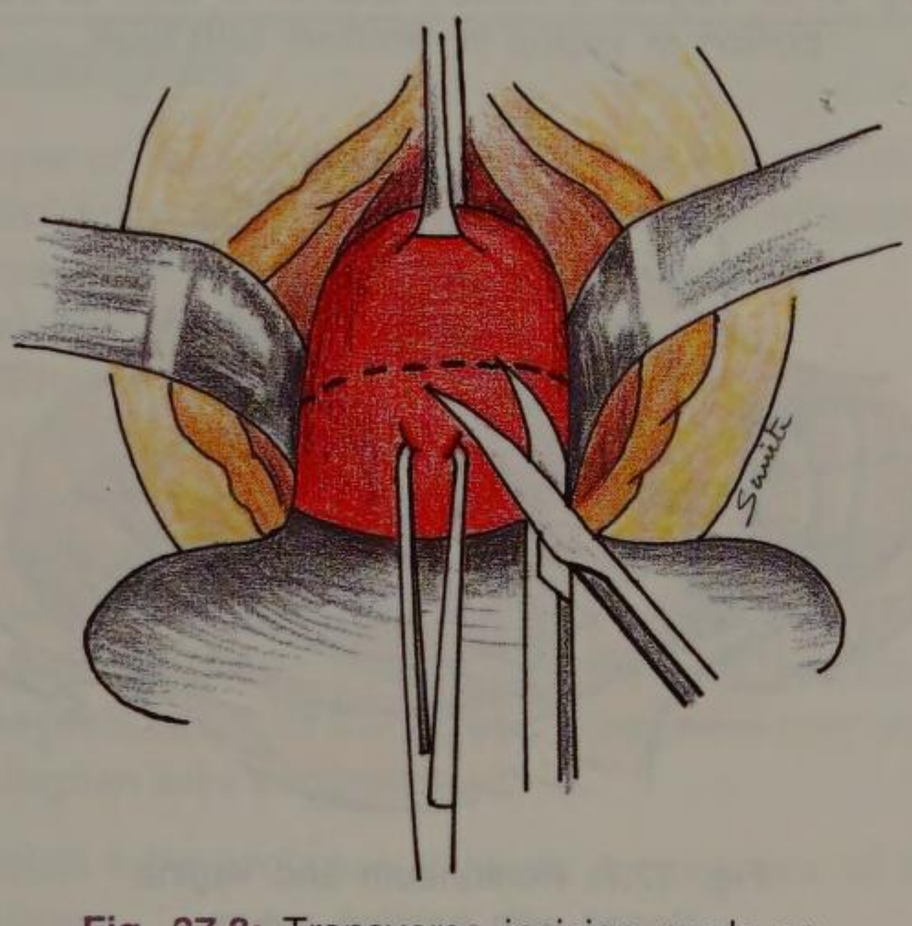

Fig. 37.8: Transverse incision made on posterior vaginal mucosa

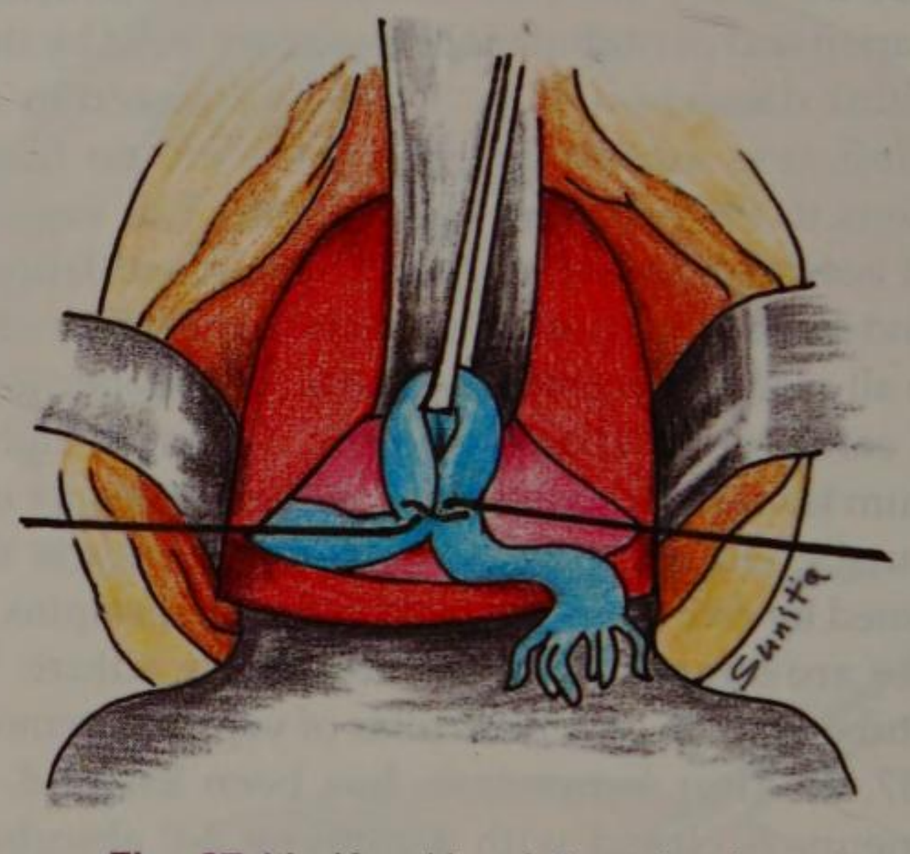

Fig. 37.11: Knuckle of the tube ligated using O chromic catgut

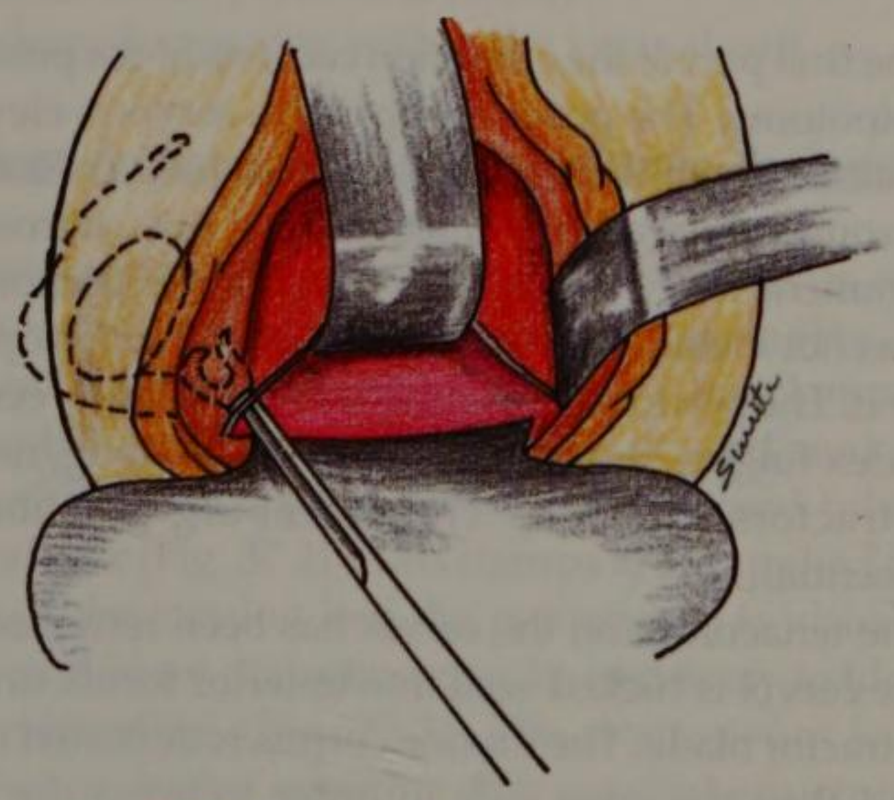

Fig. 37.9: Babcock's forceps in peritoneal cavity locating fallopian tube

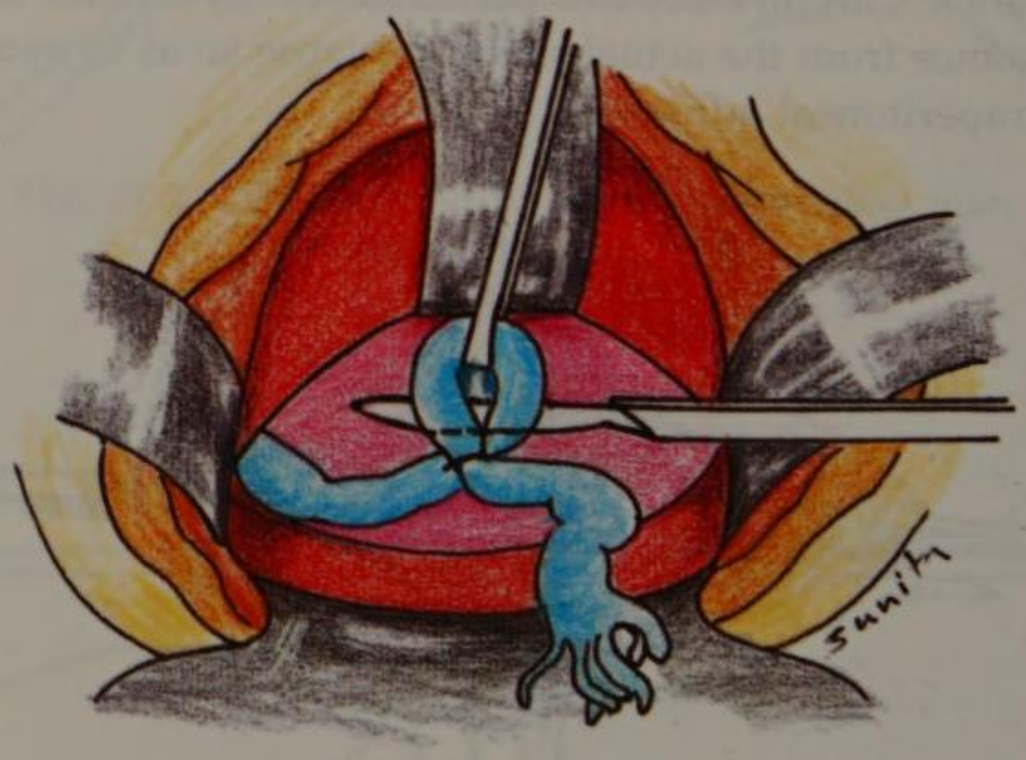

Fig. 37.12: Segment of tube being cut

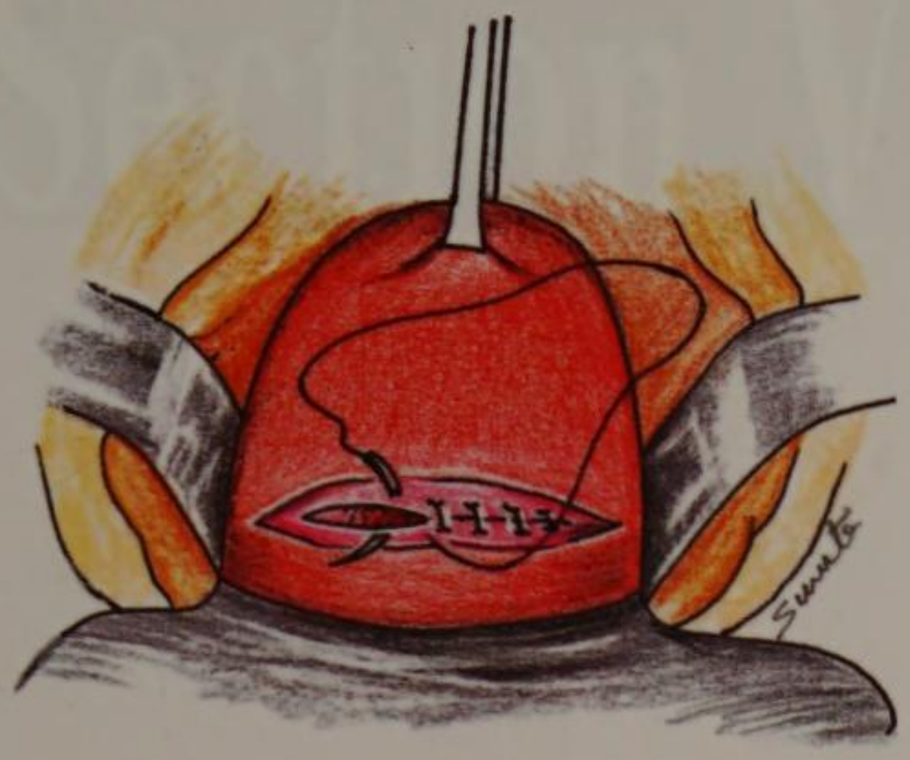

Fig. 37.13: Closure of peritoneum

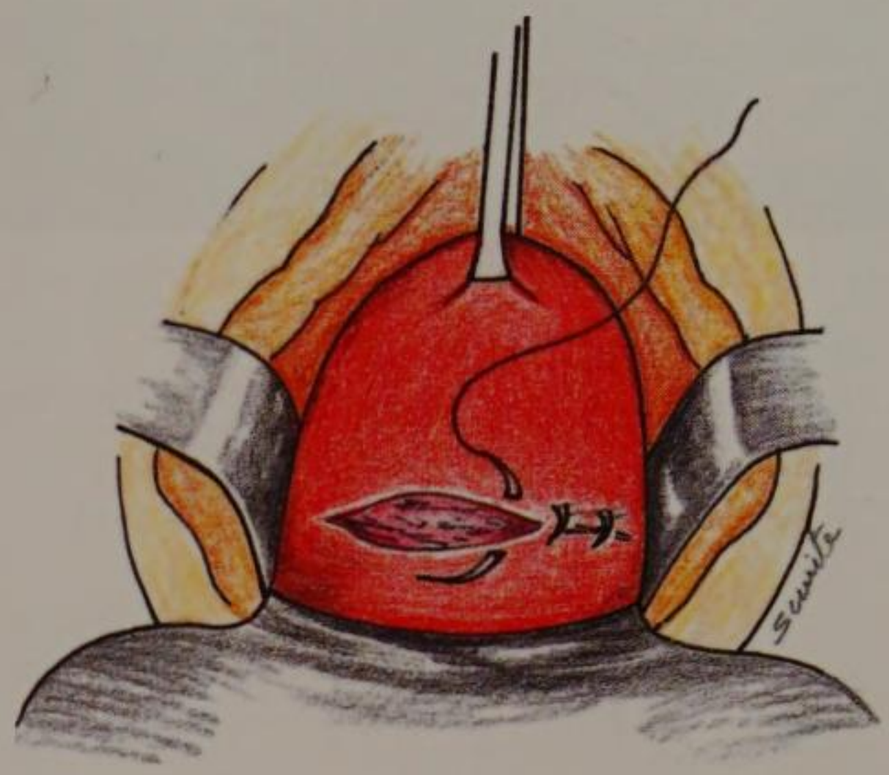

Fig. 37.14: Closure of vaginal mucosa

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Section VI

Surgery of Cervix

PHILOSOPHY OF COMFORT

SECTION IV.

38

Cervical Biopsy Techniques

Neerja Goel, Madhu Bagaria

INTRODUCTION

Cervical cancer is a common genital tract malignancy. To an estimated annual global incidence of 500,000 cervical cancers, India contributes 100,000, i.e. 1/5 of the world burden. Cervix being an exposed organ is a favorable site for effective control programme. It is easily accessible and there is usually a long latent period of intraepithelial neoplasia which is easily recognizable by the Pap smear. Recognition of cellular atypia and preinvasive changes has led to a dramatic decrease in death due to cervical cancer. Various methods of diagnostic modalities have been introduced since 1943 when Papinacalou and Traut first time introduced cervical cytology as a surface biopsy method.

There are several types of cervical biopsies. These can be done for therapeutic purposes to treat precancerous lesions as well as for the diagnostic purposes.

The biopsy techniques include:

1. Pap's smear (surface biopsy) - a cytological screening method.
2. Punch biopsy
3. Wedge biopsy
4. Cone biopsy or conization
5. Loop electrosurgical excision procedure (LEEP).

Indications of Biopsy

1. Abnormal pap's test
2. Abnormal colposcopy
3. Suspicious cervix
4. Growth on cervix
5. Polyps (benign growths) on the cervix
6. Genital warts.

Pap's Smear

It is a cytological screening technique. Pap's test is a surface biopsy of the squamocolumnar junction.[1]

Instruments used (Fig. 38.1).

a. Cytobrush
b. Ayer's spatula
c. Cusco's speculum/sim's speculum with AV wall retractor.

Indication for Pap's

1. Cervical cancer screening should begin 3 years after a woman has vaginal intercourse and no later than 21 years.
2. Till the age of 30 years, screening is done every year
3. >30 years, if 3 or more normal pap's test, then continue screening every two to three years.

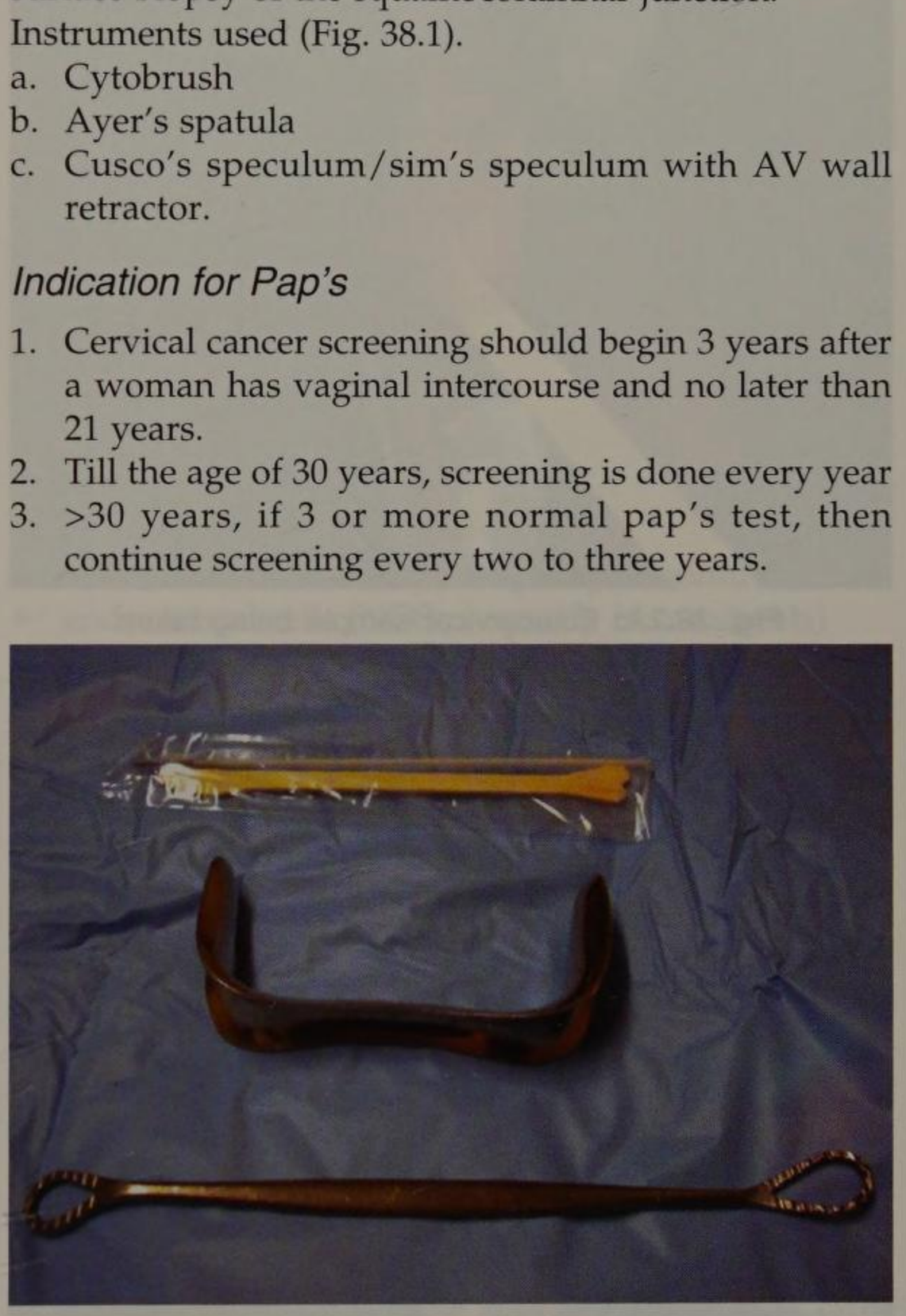

Fig. 38.1: Instruments for taking pap's

4. When 70 years or more with three or more normal pap's test and no abnormal results in the last 10 years, patients may choose to stop undergo screening.

Method [2] (Figs 38.2A to D)

1. OPD procedure.
2. Patients lie in dorsal position.
3. Vaginal speculum inserted preferably self retaining cuscos speculum.
4. Use spatula first followed by endocervical brush because otherwise the smear will be obscured by the blood.
5. Spatula is placed at the cervical os using the end that conforms to the cervical anatomy. This is rotated by 360° about the circumference of the os thereby maintaining contact with the ectocervix.
6. Sample is held and smeared on the slide.
7. Endocervical sample is collected using the cytobrush.
8. Brush is inserted along the axis of cervical canal and rotated by 90°.
9. If get rotated by >180° more chances of bleeding.
10. Sample is then unrolled on slide in a direction opposite to which it was collected.
11. The slides are immediately fixed.

Fixator used[1]—95% alcohol with 5% ether.

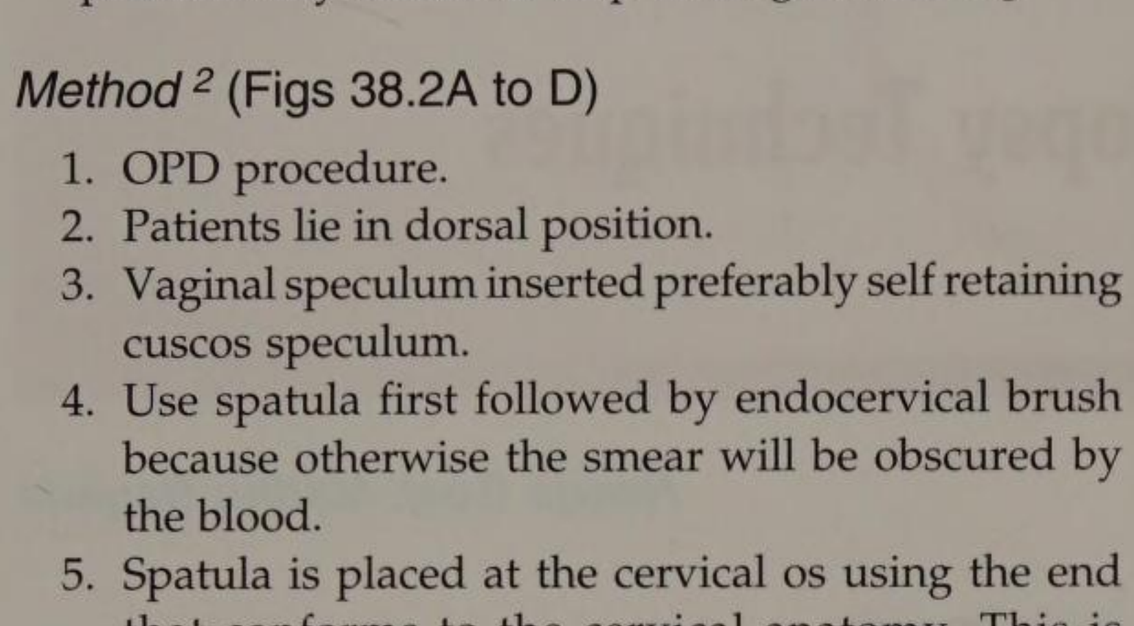

Fig. 38.2A: Ectocervical sample being taken

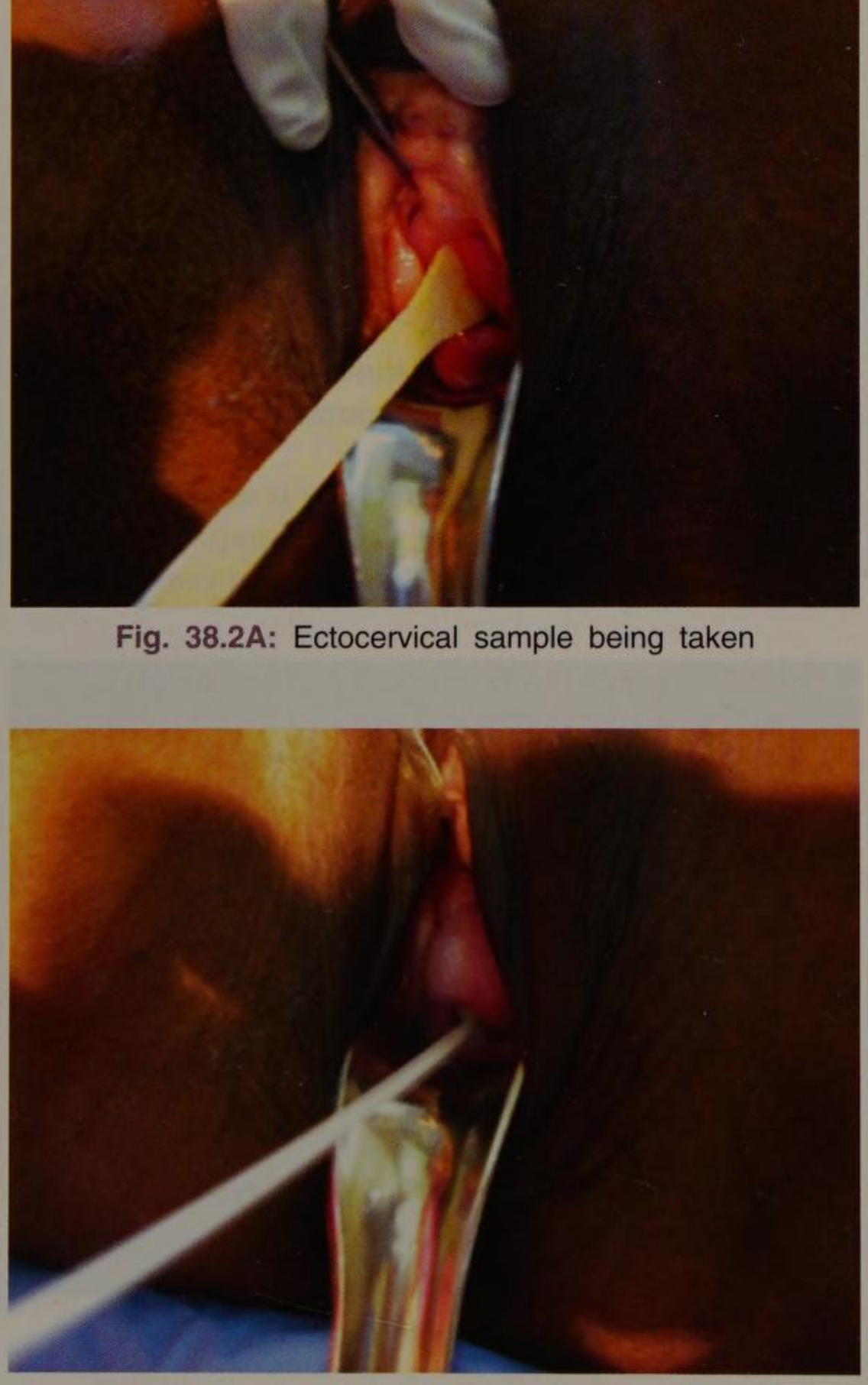

Fig. 38.2B: Endocervical sample being taken

Fig. 38.2C: Preparation of the slide

Fig. 38.2D: Fixing the slide

Reporting of Pap's Smear[3]

It is done according to the Bethesda system. In 2001 this system was revised as given below:

a. *Specimen type*: Indicate conventional smear (Pap smear) vs. liquid based vs. other
b. *Specimen Adequacy*
   1. Satisfactory for evaluation (describe presence or absence of endocervical/transformation zone component and any other quality indicators, e.g., partially obscuring blood, inflammation, etc.)
   2. Unsatisfactory for evaluation ... (specify reason)
      - Specimen rejected/not processed (specify reason)
      - Specimen processed and examined, but unsatisfactory for evaluation of epithelial abnormality because of (specify reason)
c. General Categorization (optional)
   1. Negative for intraepithelial lesion or malignancy
   2. Epithelial cell abnormality: See Interpretation/Result (specify 'squamous' or 'glandular' as appropriate)
   3. Other: See interpretation/Result (e.g. endometrial cells in a woman ≥ 40 years of age)
d. Automated Review
   If case examined by automated device, specify device and result.
e. Ancillary Testing
   Provide a brief description of the test methods and report the result so that it is easily understood by the clinician.
f. Interpretation/Result
   1. Negative for intraepithelial lesion or malignancy (when there is no cellular evidence of neoplasia, state this in the general categorization above and/or in the interpretation/Result section of the report, whether or not there are organisms or other non-neoplastic findings).

Organisms

1. *Trichomonas vaginalis*
2. Fungal organisms morphologically consistent with *Candida* spp
3. Shift in flora suggestive of bacterial vaginosis
4. Bacteria morphologically consistent with *Actinomyces* spp.
5. Cellular changes consistent with *Herpes* simplex virus.

Other Non-neoplastic Findings (Optional to Report; List Not Inclusive)

a. Reactive cellular changes associated with
   - inflammation (includes typical repair)
   - radiation
   - intrauterine contraceptive device (IUD)
b. Glandular cells status post hysterectomy
c. Atrophy

Other

1. Endometrial cells (in a woman ≥ 40 years of age)"(Specify if 'negative for squamous intraepithelial lesion')
2. Epithelial cell abnormalities
   a. Squamous cell

1. Atypical squamous cells
   - of undetermined significance (ASC-US)
   - cannot exclude HSIL (ASC-H)
2. Low grade squamous intraepithelial lesion (LSIL) encompassing: HPV/mild dysplasia/CIN 1
3. High grade squamous intraepithelial lesion (HSIL) encompassing: moderate and severe dysplasia, CIS/CIN 2 and CIN 3
   - with features suspicious for invasion (if invasion is suspected)
4. Squamous cell carcinoma

   b. Glandular cell.

Atypical

- endocervical cells (NOS or specify in comments)
- endometrial cells (NOS or specify in comments)
- glandular cells (NOS or specify in comments).

Atypical Glandular Cells, Favor Neoplastic (Specify Endocervical or NOS)

Endocervical Adenocarcinoma in Situ

Adenocarcinoma

- Endocervical
- Endometrial
- Extrauterine
- Not otherwise specified (NOS).

Other Malignant Neoplasms (specify)

Educational Notes and Suggestions (Optional)

Suggestions should be concise and consistent with clinical follow-up guidelines published by professional

organizations (references to relevant publications may be included).

Punch Biopsy

It is a surgical procedure to remove a small piece of tissue from the cervix.[1] One or more punch biopsies may be performed on different areas of the cervix.

Instruments Used[4]

Kevorkian, younge, or Gaylor cervical biopsy forceps
Sim's speculum and vulsellum.

Technique (Fig. 38.3)

- OPD procedure. It can be done under colposcopic guidance.
- No anesthesia required.
- No prior preparation, such as fasting or sedation, is required for a simple cervical biopsy
  1. Patient is placed in dorsal position after bladder emptying.
  2. Sim's speculum is inserted in the vagina to spread the walls of the vagina apart for exposing the cervix.
  3. Tenaculum may be used to hold the cervix steady for the biopsy.
  4. Area to be biopsied is identified.
  5. Biopsy is taken from the area from where frank invasion can be shown, not from the exophytic area which does not have any benign stroma.

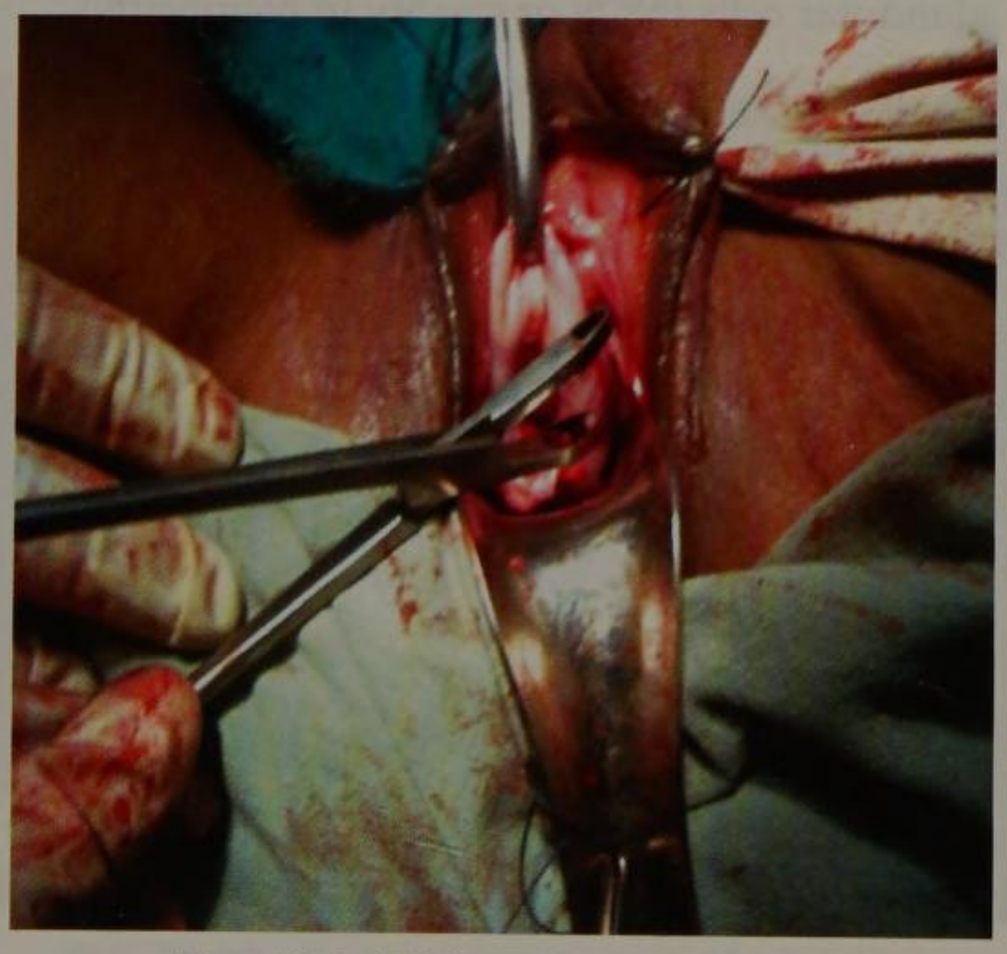

Fig. 38.3: Taking of punch biopsy

Normally the bleeding is controlled by pressure with a moist pack. Rarely a stitch is required to control the bleeding.

Wedge Biopsy

This biopsy is useful when punch biopsy is inconclusive or micro invasion cannot be ruled out.[4] This kind of biopsy has sufficient depth of stroma to rule out micro invasion.

Technique (Figs 38.4A to C)

1. Biopsy is taken with the help of scalpel blade.
2. The area to be biopsied is held with an allis forceps or a thumb forceps

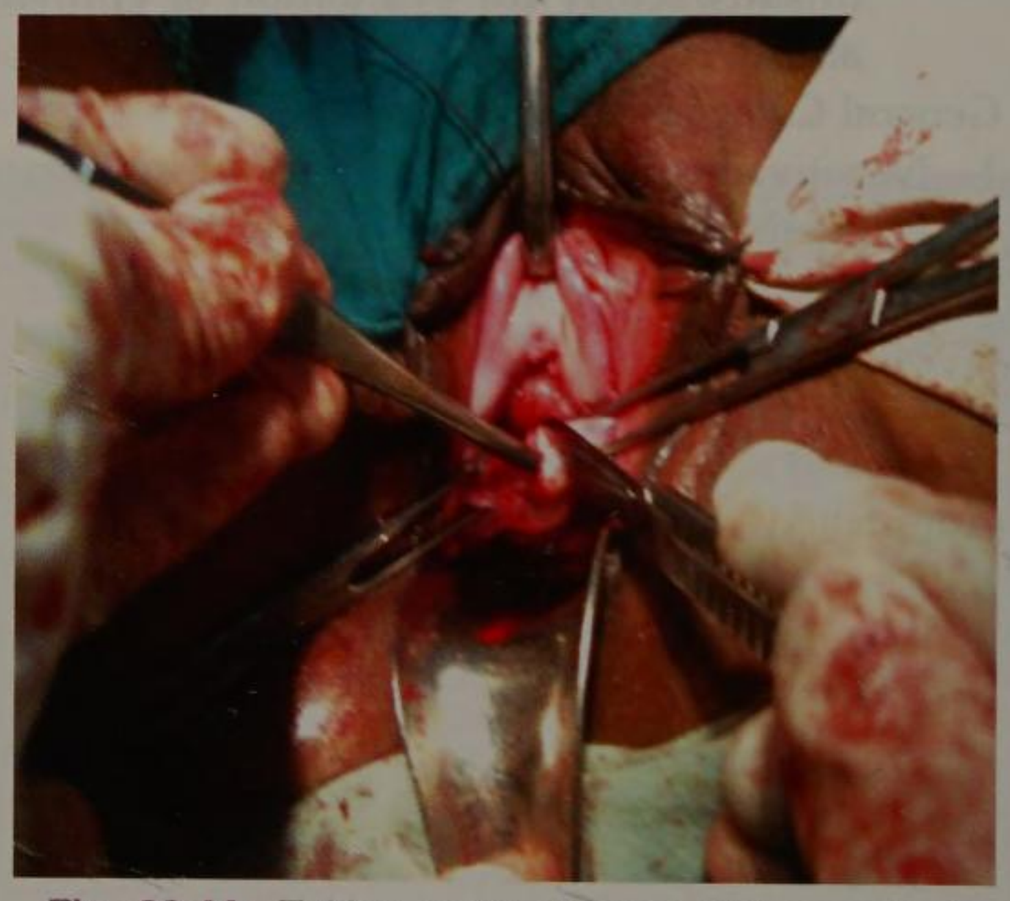

Fig. 38.4A: Taking wedge biopsy with a scalpel

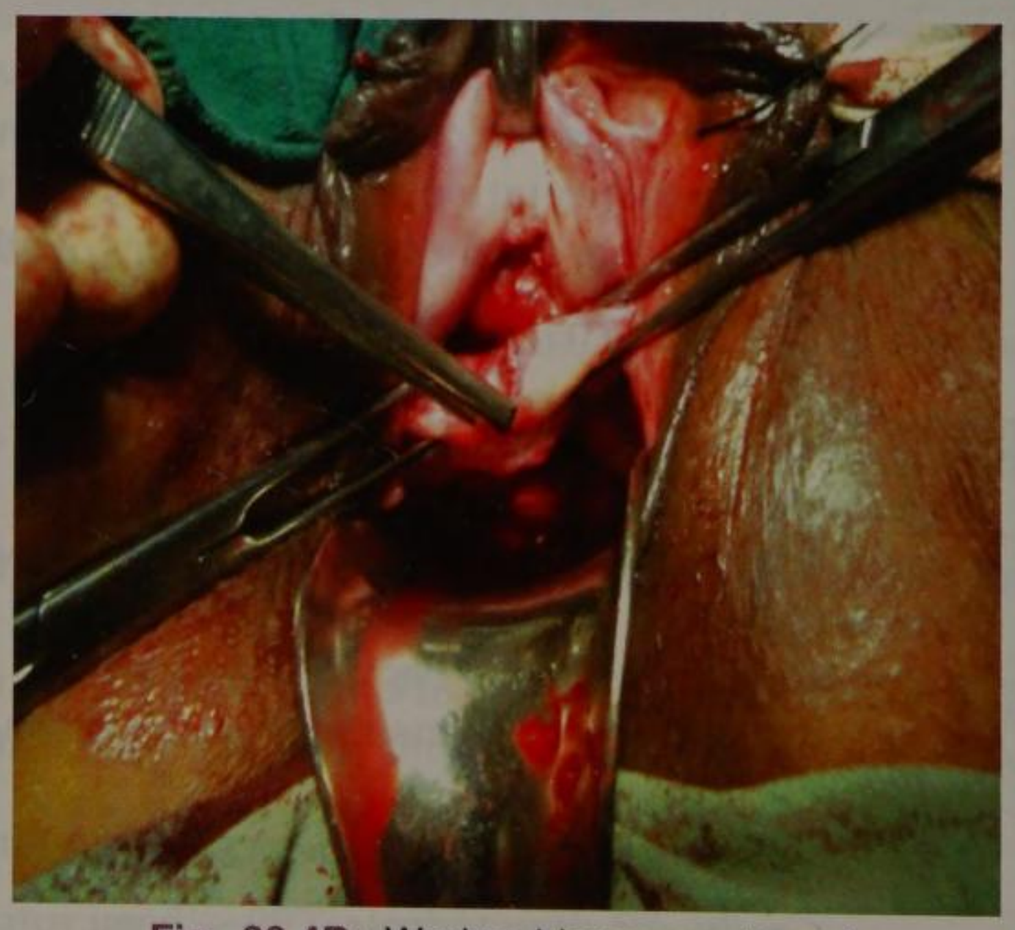

Fig. 38.4B: Wedge biopsy continued

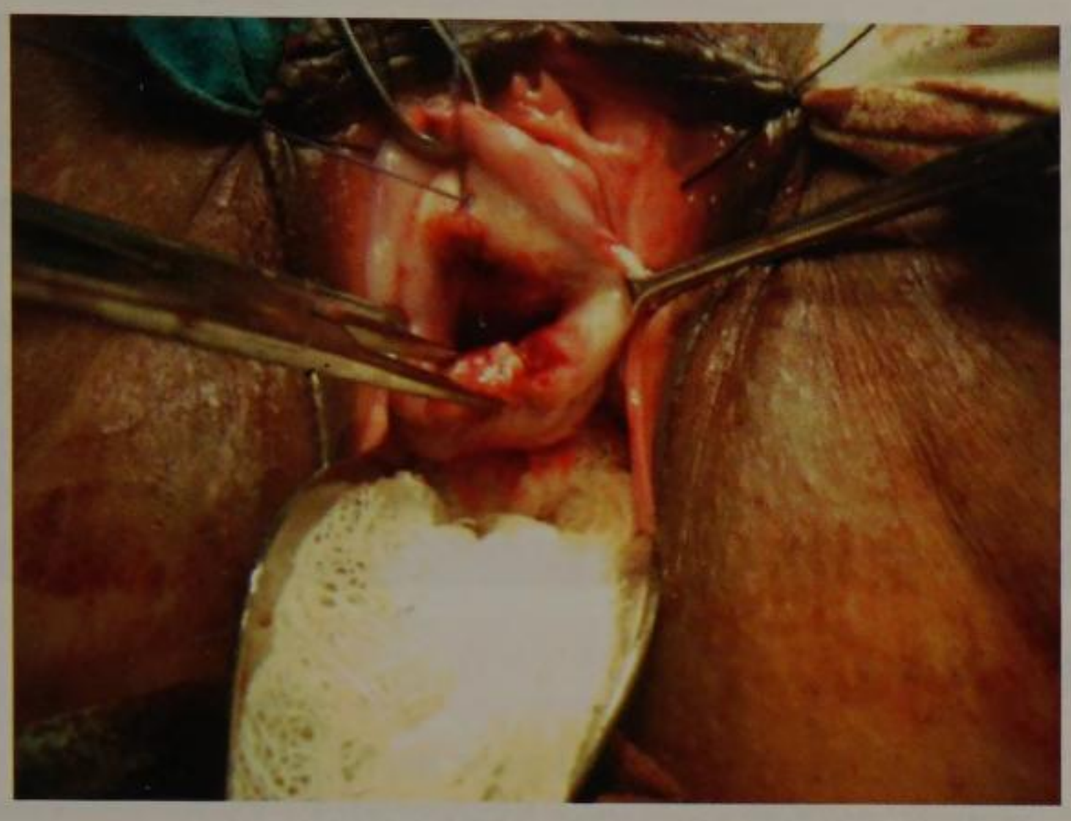

Fig. 38.4C: Cervix after taking the wedge biopsy

3. A wedge shaped chunk of tissue is removed. A suture may be needed.

Cone Biopsy

Refers to a surgical procedure where a cone shaped or cylinder shaped piece of cervix is removed.

Anesthesia required- general or regional (spinal or epidural) or local.

Different methods of taking cone biopsy are:

- Cold knife conization
- Laser conization.

Indications for Cone Biopsy[1]

1. A large area of abnormal lesion
2. Squamocolumnar junction not visible for colposcopic evaluation
3. The inner margin has receded in the cervical canal.
4. Discrepancy between cytological report and colposcopic findings.
5. Suspicion of microinvasion.
6. Abnormal endocervical curettage.

Technique (Figs 38.5A and B)

1. Cone-shaped tissue from the center of the cylindrical cervix is removed. The base of the cone is taken from the opening of the cervix (cervical os); the middle and tip of the cone, from the cervical canal.
2. The cut edges of the cervix are then sutured or cauterized.
3. If the procedure is being done as treatment, laser or electrocautery techniques may be used instead and will not require sutures.

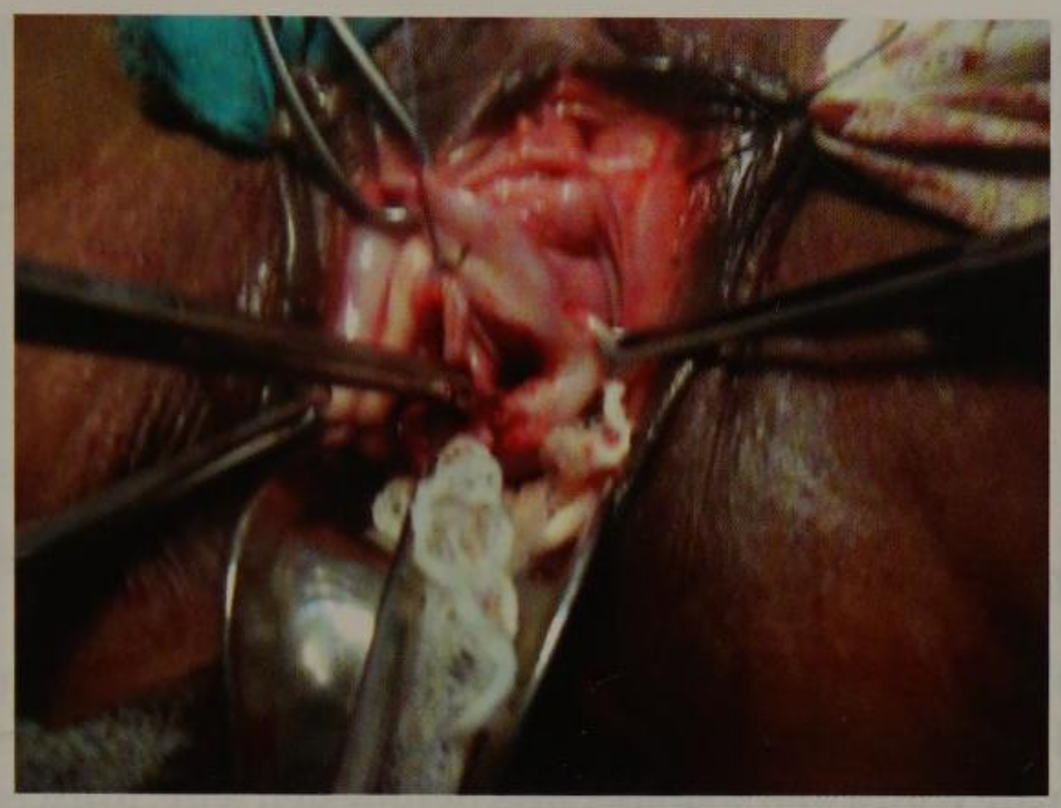

Fig. 38.5A: Cone biopsy being taken. Cervix marked at 12 'o'clock position with thread

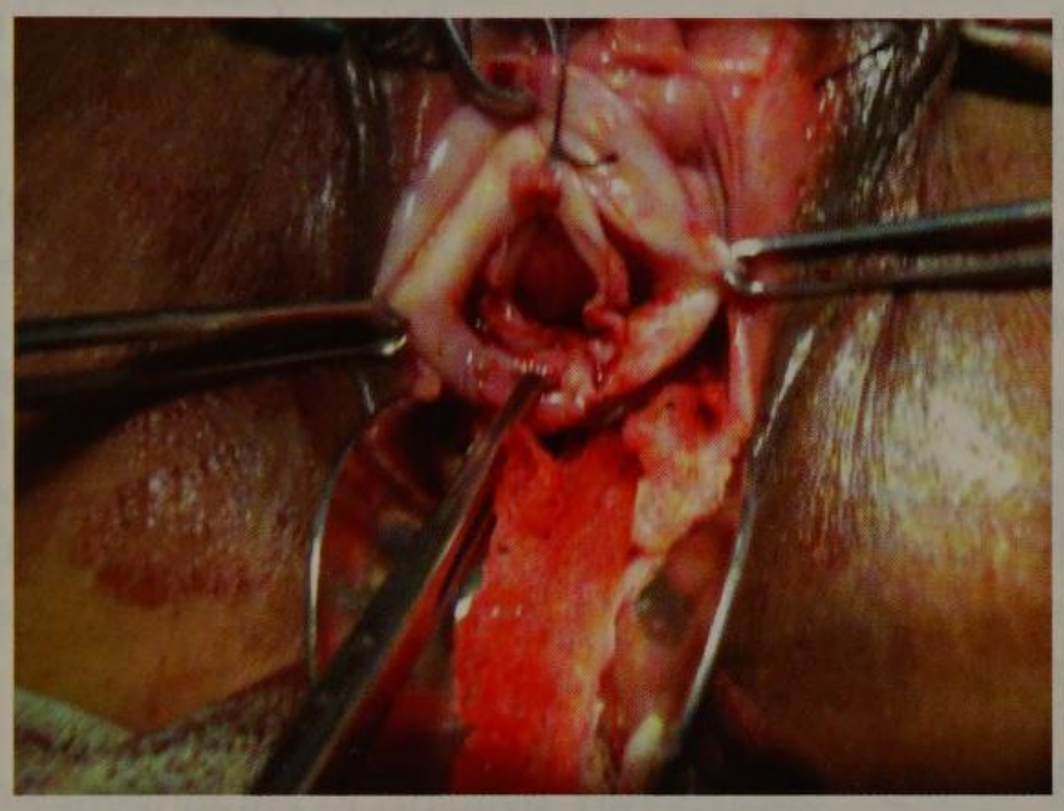

Fig. 38.5B: A cone-shaped piece of the cervix is being removed

Postoperative Care

After the procedure, the patient may experience some cramping, discomfort, or mild to moderate bleeding. The biopsy site may take up to six weeks to heal completely. The patient will be instructed to avoid intercourse, tampons, and douches for at least three weeks following the procedure.

Normal Results

Numerous studies have indicated that cone biopsy is successful in excising all cancerous tissue in 90% of patients with early stage cervical cancer.

Risks/Complications

1. Possible heavy bleeding
2. Perforation or infection of the uterus

3. Possible miscarriage from incompetent cervix
4. Possible infertility
5. Scar tissue may interfere with vaginal childbirth or menstrual flow (rare).

Advantages

- It provides a large sample.
- It may remove any cancerous tissue in the process.

Loop Electrosurgical Excision Procedure (LEEP)

It is based on the principle of modern, solid – state, electrosurgical generators coupled with loop electrodes, made with a thin stainless steel or tungsten wire, to excise areas of CIN.[3] It also electrocoagulates tissue simultaneously with a 5 mm ball electrode. It has both diagnostic and therapeutic use. Although primarily it is used to rule out invasive cancer, in few instances it may identify unsuspected adenocarcinoma *in situ*.

When disease extends into the canal, a loop endocervical excision procedure is performed with use of a 1 × 1 cm loop electrode.

If both the portio and the canal is involved a "reverse cowboy hat" shaped endocervical-portio excision is appropriate. The size of electrode for the portio excision should not be more than 2.5 cm wide and 7 mm in depth as larger electrodes may lead to inadvertent cervical amputations.

Advantages of LEEP

a. Easy to learn, easy to teach and easy to apply.
b. Cheaper than cold knife conization.
c. Margins can be examined colposcopically after the initial excisions are completed.
d. Procedure can be repeated if residual CIN remains.

When LEEP is used for small lesions in a small, nulliparous cervix caution is needed because it is possible to produce irreversible cervical damage (See Chapter 39).

CONCLUSIONS

A variety of techniques are available for cervical biopsy. Each enjoys it's own merits and demerits. Cervical cancer although a dreaded disease when diagnosed late has the advantage of being picked up at it's latent period by these technique. These biopsies can be used for both therapeutic and diagnostic purposes. The advent of leep further avoids the complications associated with conization of cervix.

Key Points

1. Cervical biopsy techniques include Pap smear, punch, wedge and cone biopsy and LEEP.
2. Pap smear should be done routinely as per screening programme.
3. Punch and wedge biopsy can be taken as an OPD procedure.
4. Cone biopsy has diagnostic and therapeutic indications.
5. LEEP is equally effective as cone but has less complications.

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39 Ablative (Cryotherapy) and Excision (LEEP) Procedures for CIN

Neerja Bhatla, Shilpa Singla

INTRODUCTION

The diagnosis of cervical intraepithelial neoplasia (CIN) and the knowledge that this is a precancerous condition often leads to great anxiety for the patient and her physician. Often this leads to a decision to perform hysterectomy. However, hysterectomy by any route is a major procedure with significant potential for short-term and long-term morbidity. It should not therefore be undertaken lightly, especially since various treatment modalities are now available for the conservative management of CIN that can be safely performed on an outpatient basis. The various techniques are shown in Table 39.1.

ABLATIVE TECHNIQUES

Ablative techniques are simple, inexpensive and easy to learn. Even paramedical workers can be taught to perform these techniques safely. The most commonly used one is cryotherapy, which is inexpensive, safe, easy to learn and perform. In carefully selected patients, cryotherapy is an effective therapeutic option as destruction to a depth of 7 mm can eradicate disease in crypts in over 99% of cases.[1]

Table 39.1: Techniques for conservative management of CIN

Ablative techniques
1. Cryosurgery
2. Electrocoagulation
3. Laser Ablation

Excisional techniques
1. Cold knife conization
2. Laser Conization
3. Loop Electrosurgical Excision Procedure (LEEP)

Prerequisites for Ablative Surgery

1. The entire lesion should be visible within the transformation zone i.e., squamocolumnar junction should be seen.
2. The probe should cover the lesion completely.
3. There should be no evidence of endocervical involvement.
4. No microinvasion or macroinvasion as proved on histological study of biopsy.
5. Cytology and histology must correspond.
6. Patient should be compliant for long term follow up.

Disadvantages of Ablative Techniques

1. No tissue is available for histopathology to verify the diagnosis on punch biopsy and to study the completeness of excision.
2. CIN 3 lesions and endocervical lesions cannot be treated reliably because of increased involvement of the crypts
3. Follow-up is more difficult if the squamocolumnar junction recedes into the endocervical canal.

Cryotherapy: Technique

The procedure is best performed in the post-menstrual period. The patient is placed in dorsal lithotomy position. Table 39.2 shows the equipment needed for cryotherapy.

A Cusco's or Grave's speculum (Fig. 39.1) is placed in the vagina, fully exposing the cervix. In cases of prolapse, the vaginal walls may partly obscure the cervix. In such a situation, a lateral vaginal retractor can be

Table 39.2: Equipment needed for cryotherapy

1. Cryogun
2. Various sizes and shapes of cryotips
3. Disinfectant for cryotips
4. Water-soluble lubricating gel
5. Large 60 kg nitrous oxide cylinder with pressure gauge
6. Vaginal speculum
7. Vaginal wall retractors
8. Colposcope with accessories
9. 5% acetic acid

Fig. 39.1: Graves' speculum

inserted or a condom can be used to cover the speculum. Its tip is snipped off and when opened the condom holds back the vaginal walls so that there is no inadvertent freezing (Fig. 39.2). The lesion is identified by colposcopy and the presence of invasive disease excluded. The nitrous oxide cylinder is activated and the pressure of the gas checked, which should be at least 20 pounds with the indicator in the green zone. With a smaller cylinder the pressure may drop in the middle of the procedure and the treatment will be inadequate.

The most suitable probe is selected according to the size of the lesion (Fig. 39.3A) and screwed onto the cryogun (Fig. 39.3B). The probe with a small central nipple generally provides the best fit. Water-soluble lubricating jelly is applied to the probe tip, which is then placed on the lesion and activated. The patient is warned that she will hear a hissing sound. If gas is leaking from around the contact area between the probe and the stem of the cryogen, the O-ring needs to be replaced. The probe should not touch the vagina. The ice ball should extend

Fig. 39.2: Speculum with condom

Fig. 39.3A: Different probes

Fig. 39.3B: Cryogun

at least 7 mm beyond the probe – this indicates the depth of treatment. If the pressure is adequate, this can be achieved in 3-5 mins. Extending the time beyond 5 mins does not usually improve results. The cryogun is now deactivated and the cervix allowed to thaw for 5 mins. The probe should not be pulled off till it is defrosted as this may cause pain and bleeding. For a double freeze technique, this procedure is repeated. Damage to the cells occurs during both freezing and thawing processes. The cellular proteins are denatured by cryonecrosis. Freezing followed by thawing results in the formation of ice crystals, expansion of intracellular contents and rupture of the cells.

Some patients may experience cramps during the procedure, which can be relieved by the administration of non-steroidal anti-inflammatory agents. Others may experience some degree of flushing and light-headedness. Almost all patients will have a profuse watery discharge for about 2 weeks, which may require the use of a sanitary towel. They should be instructed to consume plenty of fluids and electrolyte solutions during this period. Serious complications of cryotherapy are rare. Infection and secondary haemorrhage may occur. Rarely there may be cervical stenosis. There is no evidence that there is a significant effect on fertility or pregnancy outcome.[2]

EXCISIONAL TECHNIQUES

Advantage of Excisional Techniques

The main advantage of excisional techniques is that tissue is available for histopathology, which allows the diagnosis of unsuspected microinvasive or invasive disease to be made and the completeness of excision to be confirmed. Cold knife conisation (CKC) is cumbersome, requires anaesthesia and hospitalization and has more side-effects. Laser conisation requires sophisticated apparatus that is not always available. The loop electrosurgical excision procedure (LEEP) is therefore, increasingly becoming the most popular method of treating CIN. It has numerous advantages compared with the CKC, including lower cost, less procedural time, requirement of less technical skill, fewer instruments, elimination of need for operating room facilities and general or regional anesthesia, reduced blood loss, ability to perform the procedure at initial visit and the ability to remove a smaller yet adequate specimen while providing comparable cure rates as the other procedures.

LOOP ELECTROSURGICAL EXCISION PROCEDURE

Electrosurgical techniques were first introduced by Cartier in 1981 using the small loop to take biopsies and extirpate the transformation zone in strips.[3] Cartier's small loop produced cervical biopsies superior to those from punch biopsy forceps.[4] Large Loop Excision of the Transformation Zone (LLETZ) was first described by Prendiville in 1989 as a method for treatment of cervical intraepithelial lesions.[5] The acronym LLETZ was coined to differentiate the technique from Cartier's small loop biopsy method. Cartier's system did not incorporate a cutting/coagulation blend facility and it was necessary to change to coagulation mode after the biopsy was taken in order to effect hemostasis. Prendiville utilized a new generation electrosurgical unit that allowed for variable blends of small amounts of cutting and coagulation diathermy power. It had the capacity to produce a relatively constant power output at high frequency and low voltage through thin wire loops. Secondly, he considerably enlarged the actual loops so that the entire TZ could be removed in one or two pieces. Thirdly, the base of the loop was insulated to minimize the risk of diathermy damage to the surface epithelium removed.

The procedure included the removal of the entire transformation zone. This potentially reduced the risk of missing invasive cancers. LLETZ combined the advantages of local destructive techniques with those of cold knife conization (CKC) and allowed the clinician to combine diagnosis and treatment using a simple outpatient procedure under local anesthesia. The name Loop Electrosurgical Excision Procedure (LEEP) was coined later in USA but the procedure is the same. Subsequently, Needle Excision of the Transformation Zone (NETZ) has also been described. This allows the excision to be tailored more precisely to the lesion, but also requires more expertise and has not gained the same popularity as LEEP.

Indications of LEEP

The indications of LEEP are the same as of CKC:

1. Inadequate colposcopy
2. Positive endocervical curettage
3. Significant discordance between Pap smear, colposcopic findings and histological diagnoses
4. Large lesion (unsuitable for cryotherapy)
5. High grade disease on colposcopic-directed biopsy (particularly in non-compliant patient)
6. Any CIN lesion in patients with HIV

Contraindications

Absolute

1. Pregnancy
2. Bleeding dyscrasias
3. Acute cervicitis
4. Lack of ability or inadequate equipment to perform the procedure correctly or deal with possible complications.

Relative

1. Uncooperative patient
2. Vaginitis
3. Less than 3 months postpartum (increased incidence of bleeding)
4. Postcervical conization recurrence
5. Very small cervix (e.g., very young) or markedly atrophic cervix (e.g., postmenopausal patients)

Technique of LEEP

Analgesia

For most women, it is feasible to remove the transformation zone under local anesthesia. Local anaesthesia is provided by injecting 5-10 ml of 1% lignocaine with adrenaline using a cartridge syringe system (e.g., dental syringe), or a thumb syringe with needle extender or a spinal needle. Paracervical block is variably successful while local infiltration virtually achieves complete insensitivity of the epithelium to be resected.

Method

The intention of LEEP should be to remove the entire transformation zone with minimum artefactual damage to the excised biopsy. A 0.5 mm margin outside the transformation zone and a depth of 7-8 mm is considered adequate. The colposcopist should aim at removing the entire transformation zone in one piece to avoid damage to the squamocolumnar junction. However, large transformation zones may be removed in more than one pass. The average cutting time is approximately 5 to 10 seconds. Excision should be done in a single smooth motion with continuous current. Stopping the cutting current before excision is completed causes extensive thermal injury and may damage the loop. Endocervical curettage is recommended by most experts at this point (Apgar 1992).[6]

Procedure of LEEP

The patient is positioned in dorsal lithotomy position and a ground pad applied on the patient's thigh. With newer equipment, the current will not flow if this is not properly applied (Fig. 39.4). The smoke evacuator is switched on prior to the procedure and the patient explained that it

Fig. 39.4: LEEP equipment with smoke evacuator

Table 39.3: Equipment needed for LEEP

1. Electrosurgical generator
2. Patient grounding pad
3. Loop electrodes of various sizes and shapes
4. Ball electrodes (3- and 5-mm)
5. Insulated electrode handle
6. Insulated speculum with smoke evacuation port
7. Insulated vaginal sidewall retractor
8. Smoke evacuator with filter
9. Colposcope
10. 5% acetic acid, Lugol's iodine, Monsel's solution
11. 1% lignocaine with adrenaline
12. Dental-type syringe with 27 gauge needle
13. 12" needle holder with 2-0 absorbable suture
14. Specimen bottles with 10% formalin

will generate noise, which should not worry her. Without smoke evacuation it is not possible to visualize the cervix. The smoke evacuator should be equipped with a filter to prevent dissemination of viral particles into the atmosphere. An insulated Grave's speculum that is comfortable for the patient is placed in the vagina, fully exposing the cervix (Fig. 39.1). It is important to take time to position it correctly, so that the cervix is "looking at you". An insulated lateral vaginal retractor (Fig. 39.5) prevents injury to the vagina, but if this is not available a condom can be used to cover the speculum and its tip snipped off. The cervix and upper vagina are painted with Lugol's iodine to facilitate resection of the entire lesion and the squamocolumnar junction and also to provide antisepsis. Using 1% lignocaine with adrenaline, a circumferential intracervical block is performed using a 27-gauge dental/spinal needle, injecting the cervix superficially at multiple sites around the circumference of the lesion. If Lugol's iodine has not been applied, the cervix can be seen to blanch. Adequate time is given for the local anaesthetic to act.

Loops used for LEEP are made of 0.20 mm hard stainless steel or titanium wire and are available in various diameters ranging from 1 to 3 cm (Fig. 39.6). An adequate sized loop is selected and fixed onto a pencil-type holder. The size depends on the lateral extent of the transformation zone and the extent of the lesion into the endocervical canal. Depending on the loop size and thickness, a power setting from 50 to 55 watts of blend cutting plus coagulation current is used for excision. A thinner wire causes less thermal damage. Current is

Fig. 39.5: Insulated lateral vaginal wall retractor

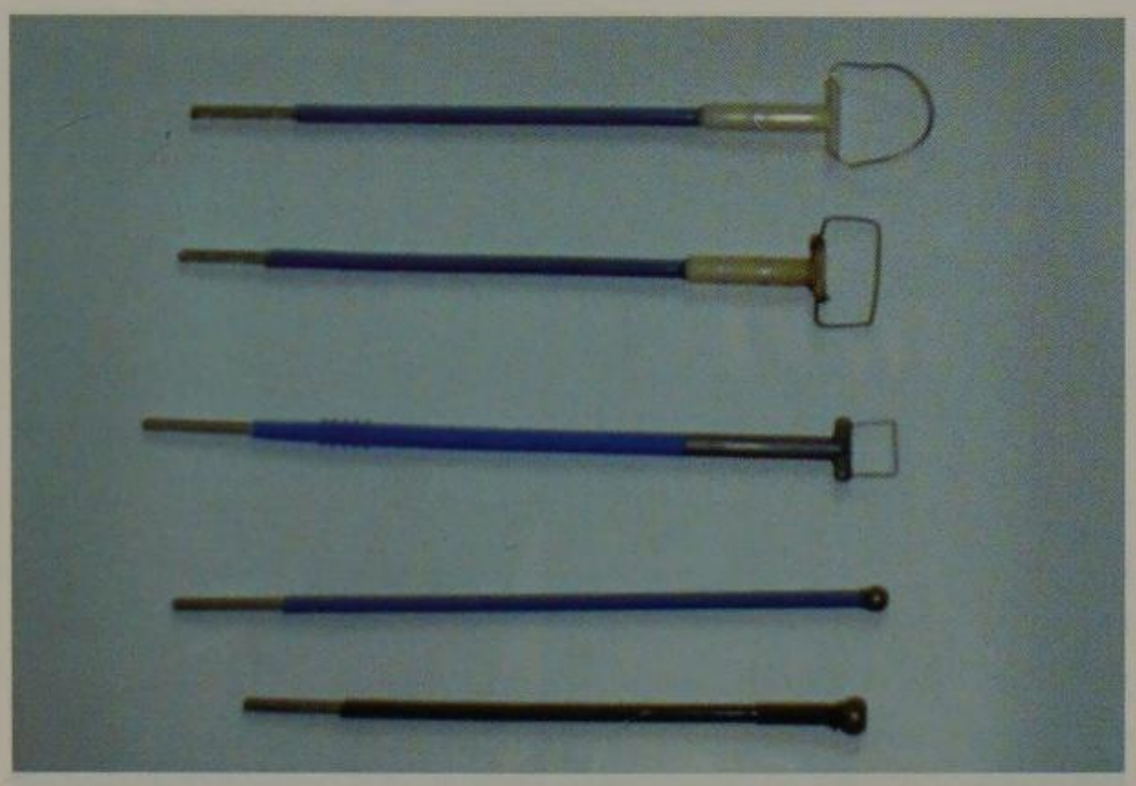

Fig. 39.6: Selection of loops and roller balls

activated by pressing a button on the holder or pressing a foot pedal. The entire procedure is done under colposcopic visualization (Figs 39.7 and 39.8). Electrocoagulation is started before entering the tissue and excision of the ectocervix is performed, taking care to control the movement of the loop in the tissue. Smaller loops can be inserted to the hilt. Care is taken with larger loops not to enter to a depth of >1 cm in general. The loop is gradually moved across from right to left. The current generates a steam envelope that cuts the tissue

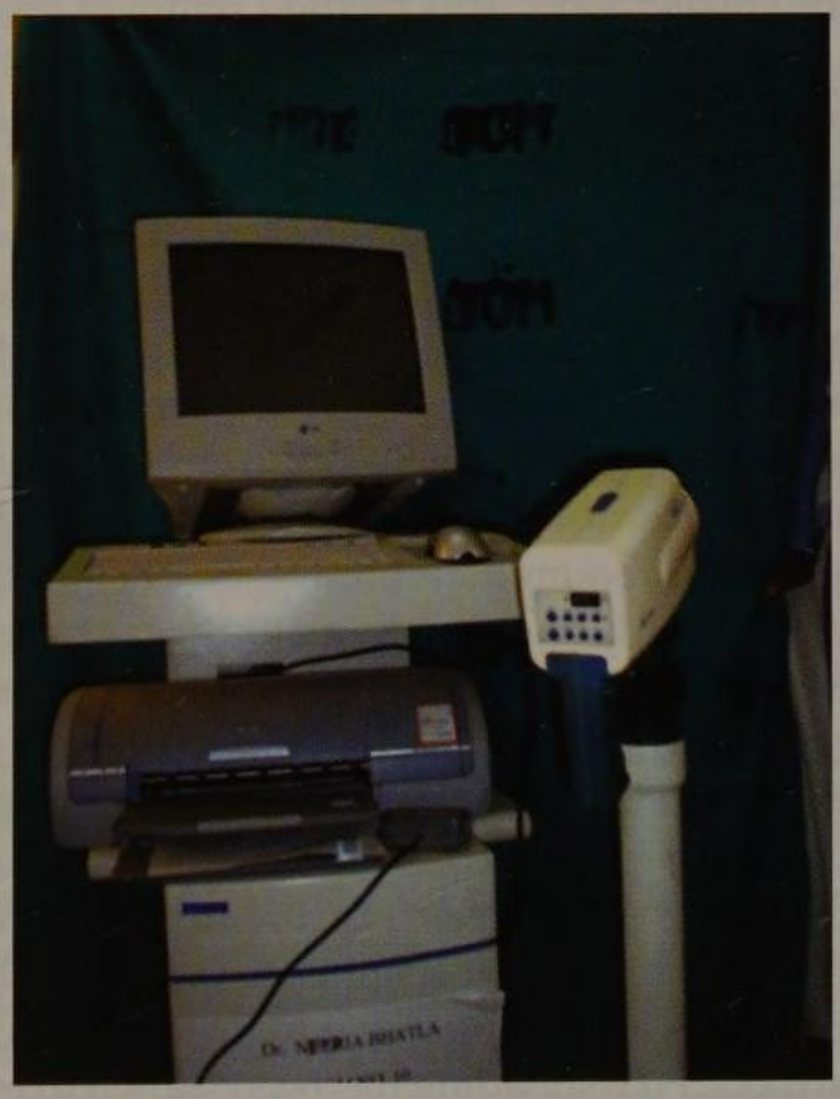

Fig. 39.7: Colposcope

Fig. 39.8: Instrument tray for colposcopy

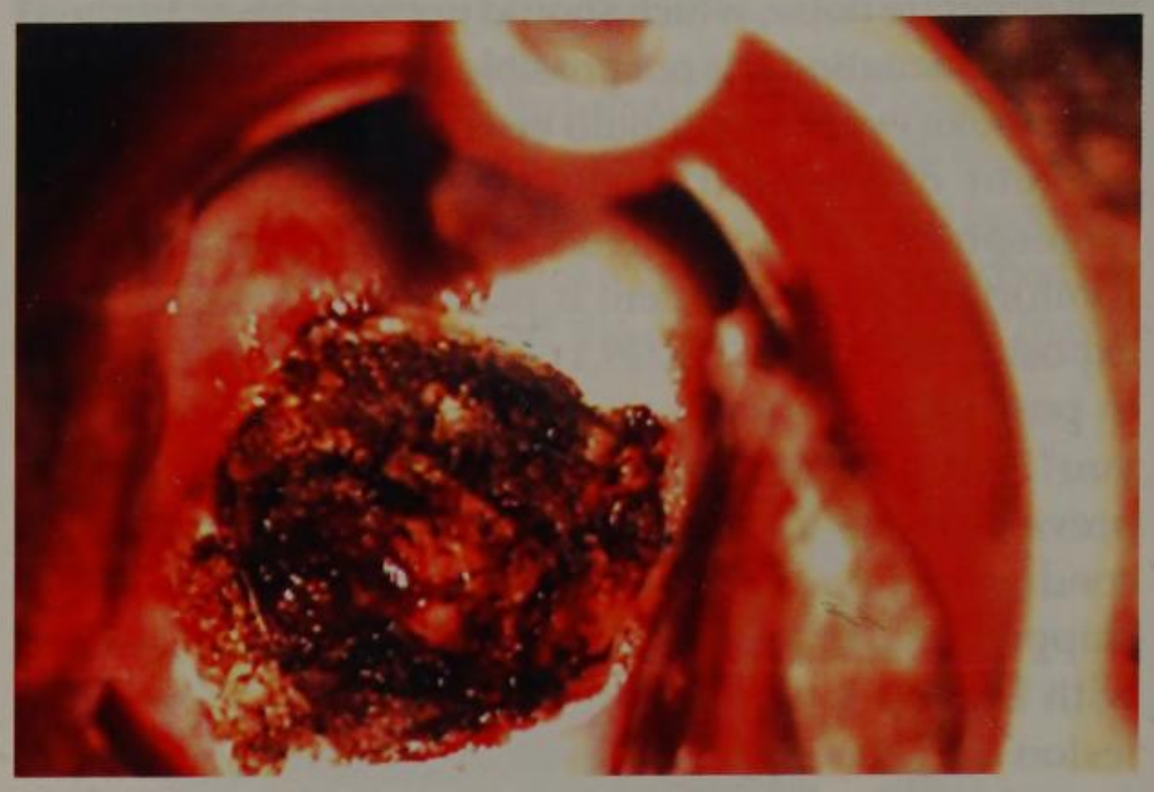

Fig. 39.9: Picture of cervix at end of procedure

and not direct contact of the loop. Care should be taken not to drag or bend the loop. On reaching the opposite end, the loop is withdrawn carefully. Every attempt should be made to remove the entire lesion in a single specimen and with a single pass. Larger lesions can be removed in multiple passes, starting with the central specimen, then posteriorly and last of all anteriorly (Fig. 39.9). If endocervical excision is needed, a smaller loop (usually 0.8 cm in width) is used for the second pass, removing the region around the endocervical canal in "top hat" fashion. The power setting is lowered when using the smaller loop. This method removes less tissue than a deeper LEEP cone but causes more thermal damage to the tissue. Specimens must be labeled and sent for histopathological examination in 10% formalin.

The crater is cauterized using the ball electrode and a pure coagulation current of 50 watts to ensure hemostasis (Fig. 39.9). This step may also help to treat residual disease in the margins. If required, the surgical defect is coated with Monsel's paste to ensure hemostasis. If hemostasis is not satisfactory, temporary vaginal packing may be required in some cases. The pack can be removed after 4-6 hours. Rarely, a suture may be required for haemostasis. Postoperatively the patient is advised abstinence for four weeks. During this period she should avoid examination or insertion of any substance into the vagina, including the use of tampons, douching, etc. and should report any excessive bleeding, abnormal discharge, pain or fever. If abstinence is not possible, the use of condoms is recommended to prevent infection to both partners. HIV shedding has been shown to increase post-therapy. Antibiotics do not have a proven role.

The histopathology report should be available in a week. Follow up is recommended at 1 month and at 6-9 months. At 1 month, healing is checked and any evidence of infection or cervical stenosis looked for. Further management depends on the histopathology report, the presence of residual disease in the margins and the presence of invasion.

Advantages of LEEP

1. It is an easily learnt technique.
2. Compared to CKC, it uses inexpensive readily available equipment and has low operating costs.
3. Capacity to tailor the procedure to meet the extent of the lesion and the goals of resection, irrespective of the size and site of the transformation zone.
4. It allows the histologic audit of the cytological and colposcopic diagnosis.
5. It allows histopathological confirmation to rule out microinvasion.
6. It is usually an office or outpatient procedure performed under local anesthesia.
7. It may be performed at the first colposcopic examination: "See and Treat" protocol.

Disadvantages of LEEP

1. Potential for excessive thermal destruction and specimen morcellation if performed incorrectly
2. Thermal injury to the vagina

Post-LEEP Complications

One of the greatest advantages of LEEP is the marked reduction in rates of both short- and long-term

complications as compared to other treatment modalities. Dunn (2004) reported an overall complication rate of 9.7%, with a major complication rate of 0.6% and minor complication rate of 9.1% among 557 women who underwent outpatient LEEP.[7] Major complications included one patient each with bowel injury, hemorrhage and a case who needed prolonged observation for chest pain. Minor complications included abdominal pain, vaginal bleeding, vaginal discharge and bladder spasm. There was no association between age, parity, risk factors for cervical dysplasia, indication for procedure or pathology of specimen with acute complications.

The main long-term morbidity after LEEP relates to pregnancy outcome and cervical stenosis:

1. *Pregnancy outcome*
   The largest series was conducted by Bigrigg (1990) in 1000 patients, which was followed up by Hafferden et al (1993).[8,9] They found no difference in the characteristics of pregnancy between the 194 women who had conceived after LEEP and a matched control group. The indices examined included gestational age, birth weight, prolonged labour, induction rate, and mode of delivery. They concluded that LEEP appeared to have no adverse effect on subsequent pregnancy and fertility. It was found to be a reliable, well tolerated, inexpensive and efficient technique for the management of CIN. This outpatient procedure is especially recommended in younger patients, because diathermy loop excision preserves the function of the cervix. Similar findings were reported in other studies.[10,11]
2. *Cervical stenosis*
   Baldauf (1996) defined stenosis as cervical narrowing that precluded insertion of a 2.5 mm Hegar dilator.[12] The reported frequency of cervical stenosis after loop excision ranges from 1.3 to 5.2%.[11-13] The volume of tissue removed and endocervical lesion were the only independent risk factors.
3. *Cervical incompetence*
   Removing unnecessarily excessive amount of cervical tissue may lead to cervical incompetence.[7] This can be avoided by using appropriately designed loop electrodes and carrying out LEEP under colposcopic guidance.[14]

Success Rates

LEEP is associated with a high success rate in terms of subsequent normal cytology and colposcopy when compared to local destructive techniques. A success rate of over 90% has been reported with LEEP varying from 95% if the margins are negative to about 70% if they are positive. Other risk factors for recurrence of cervical dysplasia include large lesion, CIN 3 and endocervical lesion.

Follow-up

All women who have been treated for CIN need regular follow-up as they remain at risk of recurrence. Even women who have undergone hysterectomy need cytological surveillance as they are at risk of developing vaginal intraepithelial neoplasia. Cytology should be repeated 4-6 months after the procedure. The endocervix may be sampled by endocervical curettage or cytobrush to predict residual disease, specially in patients with cervical adenocarcinoma *in situ*. HPV DNA testing is emerging as a useful adjunct for post treatment surveillance. If cytology and HPV are negative at 8 months, the risk of recurrence is minimal (2001 ASCCP guidelines). Patients with involved margins and positive HPV-DNA are at higher risk for residual disease compared to those with involved margins who tested negative for HPV.

Key Points

1. Conservative methods of treating CIN are inexpensive, easy to learn and perform and devoid of serious side effects.
2. The cure rate with these methods is over 90%.
3. Cryotherapy is a suitable method for treatment of CIN lesions located on the ectocervix of size not exceeding two quadrants.
4. Larger lesions and lesions of CIN 3 are best treated by LEEP.
5. Hysterectomy is not indicated for the management of CIN.
6. Cryotherapy and LEEP do not affect future fertility and pregnancy outcome.

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40

Cervical Incompetence and Cervical Cerclage Techniques

Kanwal Gujral, Nidhi Khera, Chandra Mansukhani

INTRODUCTION AND HISTORICAL PERSPECTIVE

That the orifice of the womb is so slack that it cannot rightly contract itself to keep in the seed was realized during the time of Renaissance, although the term *"cervical incompetence"* was first described in Lancet in 1865. The first surgical procedure for repair of cervix in non pregnant state was described by Lash and Lash in 1950.[1] The pioneering work of Dr. Shirodkar on cervical encerclage technique during pregnancy[2] will go down in history as a golden milestone. He described the classical Shirodkar operation in 1955 using fascia lata strips. McDonald later in 1957 described his purse string suture.[3] The next three decades saw the emergence of various modifications of cervical encerclage procedures both transabdominal and transvaginal, Wurm (1961),[4] Benson and Durfee (1965),[5] Novy (1982)[6] and recently by laparoscopic approach (Scibetta, 1998).[7] Despite a variety of procedures McDonald stitch remains the most widely practiced procedure because of its simplicity, ease of application, removal and low risk of complications.

The term cervical incompetence is not widely appreciated now as this suggests a permanent state rather than a variable dysfunction. Recent work has clearly demonstrated that the cervix is a dynamic structure, cervical compliance is a continuous process and cervical length varies from woman to woman.[8-10] Also the term cervical incompetence carries with it a negative connotation. Thus, there is a suggestion to replace the term cervical incompetence with *'cervical insufficiency'* or *'premature cervical dilatation.'*

True incidence of cervical incompetence is difficult to ascertain but majority of reports quote an incidence of 0.05%-0.26%, although it can complicate upto 1% of pregnancies. In recurrent pregnancy losses, cervical incompetence may be the underlying aetiology in 10%-25% of cases.[11]

Aetiology of cervical incompetence is obscure but broadly the causes can be either congenital or acquired. Congenital factors include DES exposure in utero, Mullerian fusion abnormalities or a physical weakness of the cervix or as a part of connective tissue disorders. Associated acquired factors are previous cervical dilatation, cervical conization, cauterization, Loop electrosurgical excision of transformation zone (LEEP) and cervical amputation.

There is a growing body of evidence which suggests that some local inflammatory process (vaginal, intrauterine) or decidual haemorrhage can induce biochemical changes in the cervix making it short, incompetent or insufficient to carry the pregnancy to term.

Diagnosis

The classical diagnostic features which suggests cervical incompetence is history of one or more spontaneous mid-trimester abortions preceded by painless dilatation of the cervix or rupture of membranes, with each successive loss occurring at an earlier gestational age than the previous one.

Symptoms that may accompany cervical incompetence are:

1. Urinary frequency
2. Lower abdominal pressure
3. Bearing down sensation
4. Bloody show or discharge.

The diagnosis of cervical incompetence can also be aided by the following tests:

Non-Pregnant State

1. Passage of No. 8 Hegar's dilator without resistance.
2. Passage of No. 16 Foley's catheter without resistance.
3. Wide or funnel shaped internal os at hysterosalpingography.

During Pregnancy

1. Vaginal examination to assess length of cervix and internal os is not recommended today as the length assessed by vaginal examination is fallacious (supravaginal portion of cervix cannot be assessed) and attempts to assess internal os with finger may itself dilate the internal os further given the susceptibility to dilatation.
2. The advent of *endovaginal sonography* has given new insights into the diagnosis of cervical incompetence. Cervix is neither competent nor incompetent but rather a continuum of process from good competence to poor competence. Cervical effacement begins at internal os and proceeds distally through a process called funneling which shortens the cervix and dilates the external os eventually leading to preterm birth. Median cervical length is 35-45 mm from 14-22 weeks, falls to approximately 35 mm between 24-28 weeks, to 30 mm after 32 weeks and displays a bell shaped curve distribution with 50th percentile at 35 mm; 10th and 90th percentile at 25 mm and 45 mm respectively.[10, 12-16] Based on the above observations and the work of others the following sonographic indicators of cervical incompetence have been proposed.[17-19]

1. Endocervical length of < 25 mm
2. Cervical canal width of > 7 mm
3. Internal os diameter of > 15 mm in the first trimester and > 20 mm in the second trimester
4. Funnel length > 25% of the endocervix
5. Bulging of membranes into the cervical canal.

The diagnostic accuracy is further improved by the use of provocative tests like an upright maternal position, coughing or transfundal pressure causing one or more of the following:[20-23]

1. A decrease in endocervical length to less than 25 mm or a 33% shortening from the previous length.
2. Funneling of the internal os.
3. Descent of membranes into the os.

The transfundal pressure technique appears to be superior to the other two methods.[22]

More recently it has been demonstrated that a longitudinal assessment of the cervix from 15-24 weeks gestation showing shortening of the endocervical canal of more than 0.52 cm/week between 15-19 weeks and 0.49-0.8 cm/week between 20-24 weeks either spontaneously or after the application of transfundal pressure and may be useful in the detection and management of cervical incompetence in high risk women.[24] Thus, a serial assessment of cervix every two weeks beginning at 15 weeks upto 24 weeks is recommended.

Indications for Cervical Encerclage

1. Patients with classic history suggestive of cervical incompetence (History of recurrent mid-trimester pregnancy losses preceded by painless dilatation of the cervix in the absence of other causative factors with each successive loss occurring at an earlier gestation than the previous one).
2. Ultrasound suggesting progressive cervical shortening or effacement in a patient whose gynecological history has suggested cervical incompetence.
3. Incidental finding of short cervical length or funneling on a routine mid trimester ultrasound.
4. Emergency Cerclage: Patient with advanced cervical dilatation and bulging of membranes in the cervical canal or vagina.

Contraindications

1. Rupture of membranes.
2. Presence of uterine contractions.
3. Intrauterine fetal demise.
4. Malformed fetus.
5. Evidence of sepsis.
6. Cervical dilatation more than 4 cm and effacement more than 75%.
7. Gestational age greater than 26 or 28 weeks.

Preoperative Evaluation

1. Gestational age should be between 12-16 weeks, usually after 14 weeks.
2. Confirm fetal viability and diagnosis of cervical incompetence.
3. Rule out fetal anomalies.
4. Screen for genetic abnormality, biochemical screen in first trimester with nuchal translucency.
5. Screen for vaginal infections: Wet smear for trichomonas, gonococcus, chlamydia, Group B *Streptococcus*, bacterial vaginosis.

SHIRODKAR'S CERCLAGE

1. *Principle*: Placement of an encircling suture at the level of internal os after reflecting the bladder.
2. *Anaesthesia*: Preferably general anaesthesia.
3. *Position*: Lithotomy plus 15° Trendelenberg.
4. *Preparation;* Betadine.
5. *Suture*: Maternal fascia lata (as used originally by Shirodkar, no longer used today).

No. 1 double braided silk, No. 1 or 0 nylon, Merselene tape 5 mm, Dacron.

Technique as Originally described by Shirodkar[2]

1. A strip of fascia lata is removed from the outer side of the thigh "quarter of an inch wide and four and a half inches long " and each end of this is transfixed with a linen suture.
2. The cervix is pulled down and a transverse incision is made above the cervix as in anterior colporrhaphy and the bladder is pushed well up above the internal os.
3. The cervix is then pulled forwards, towards the symphysis pubis, and a vertical incision is made in the posterior vaginal wall, again at and above the internal os, going only through the vaginal mucosa.
4. Through the right and left corner of the anterior incision an aneurysm needle is passed between the cervix and the vaginal wall till its eye comes out of the posterior incision.
5. The linen attached to each end of the fascia through the eye of the aneurysm needle is passed and pulled, the right end of the fascia retrovaginally forwards, into the anterior incision. The same is done on the left side.
6. The two ends of the strips are crossed to each other in front of the cervix and tightened so as to close the internal os. The left index finger in the internal os will tell you how much to pull on the strips. The assistant should be holding one end of the strip with an artery forceps.
7. The two ends are stitched together by a number of stitches which take a bite of the muscle fibres of the lowest part of the lower uterine segment using a small curved needle and fine linen.
8. Extra-portions of the fascia are cut out and the anterior and posterior incisions are closed with chromic catgut No. 0.

The patient is kept in bed for a fortnight and then gradually allowed to walk. She should not lift weights and must not strain at stools. Any painful contractions of the uterus after the operation are best relieved by tocolytics.

Modified Shirodkar Operation

Dr. Shirodkar later made a few modifications to his original technique like tying of the knot posteriorly in order to facilitate its removal later and allow a vaginal delivery and the use of Dacron suture instead of fascia lata or merselene tape.[25] The detailed steps are described as follows:

1. Posterior vaginal wall is retracted with Sim's speculum.
2. Anterior and posterior lips of the cervix are held separately with a ring forceps.
3. Patient's bladder is not usually emptied as a slightly full bladder helps in better identification of its border with the cervix.
4. Adrenaline diluted in saline is infiltrated under the posterior vaginal mucosa to create a plane of dissection as well as to minimize the blood loss. A vertical incision about ¾ inch long is made high up above the posterior cervico-vaginal junction (Fig. 40.1).

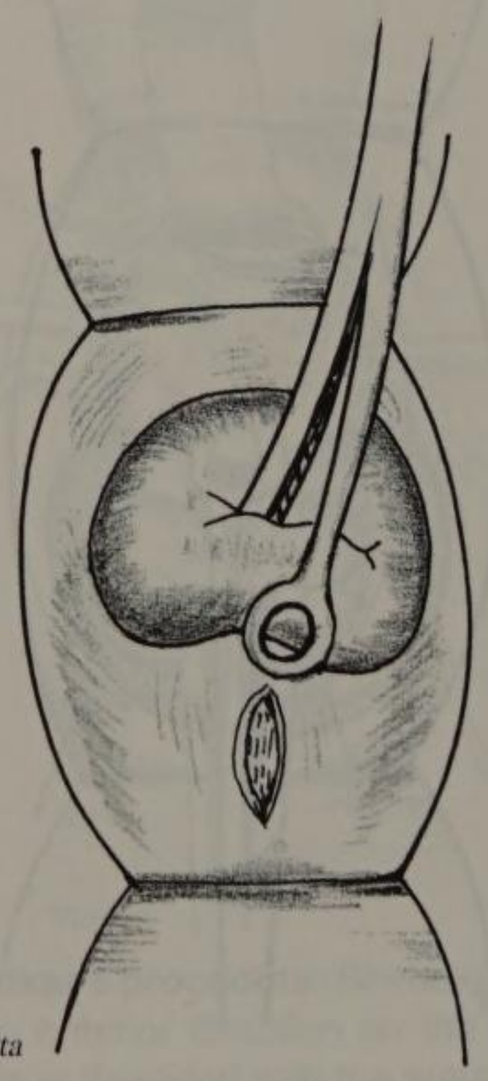

Fig. 40.1: Shirodkar's procedure: A vertical incision is made above the posterior cervicovaginal junction

5. A stay suture of catgut may be taken at the lower end of the posterior incision for identification later
6. The anterior cervicovaginal junction is infiltrated with adrenaline solution and a transverse 1-2 cm incision is made on the anterior cervical lip below the level of bladder reflection (Fig. 40.2).
7. The bladder is then pushed upwards, dissecting it off the cervix. This can be done with a combination of both sharp and blunt dissection using a fine Mayo scissors and a piece of gauze or finger.
8. Ideally the bladder should be dissected off the cervix to expose the reflection of the peritoneum from the bladder on the uterus and this point is actually higher than the expected level of the internal os.
9. A Shirodkar needle or an aneurysm needle or a ligature carrier is introduced from anterior to posterior incision submucosally between the vagina and the cervix (Fig. 40.3).
10. One end of the double strand of the desired suture is passed through the eye of the ligature carrier. Engaged thread is pulled in and upward to emerge anteriorly (Fig. 40.4).

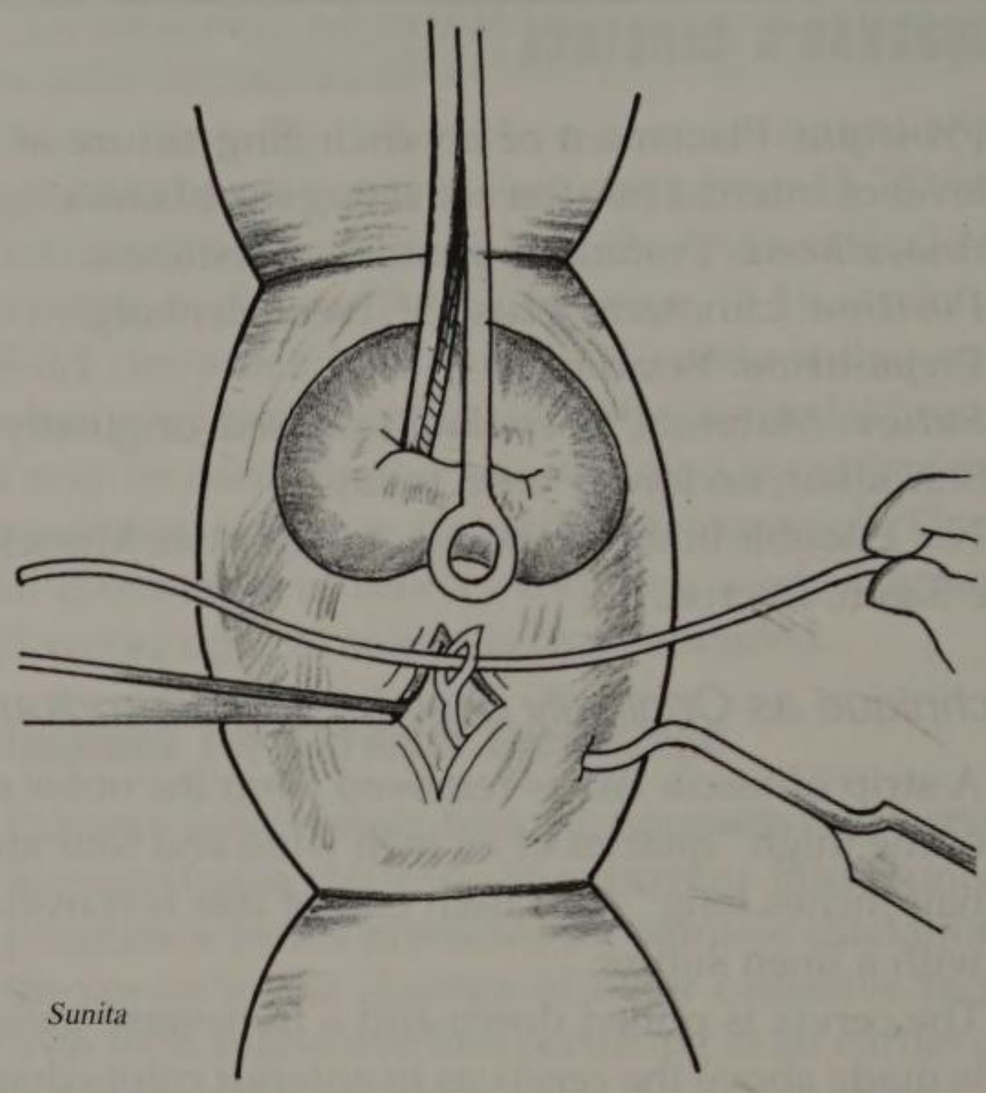

Fig. 40.3: Shirodkar's procedure: Shirodkar needle is introduced from anterior to posterior direction submucosally between the vagina and the cervix and the eye of the needle is threaded with the suture of the desired material

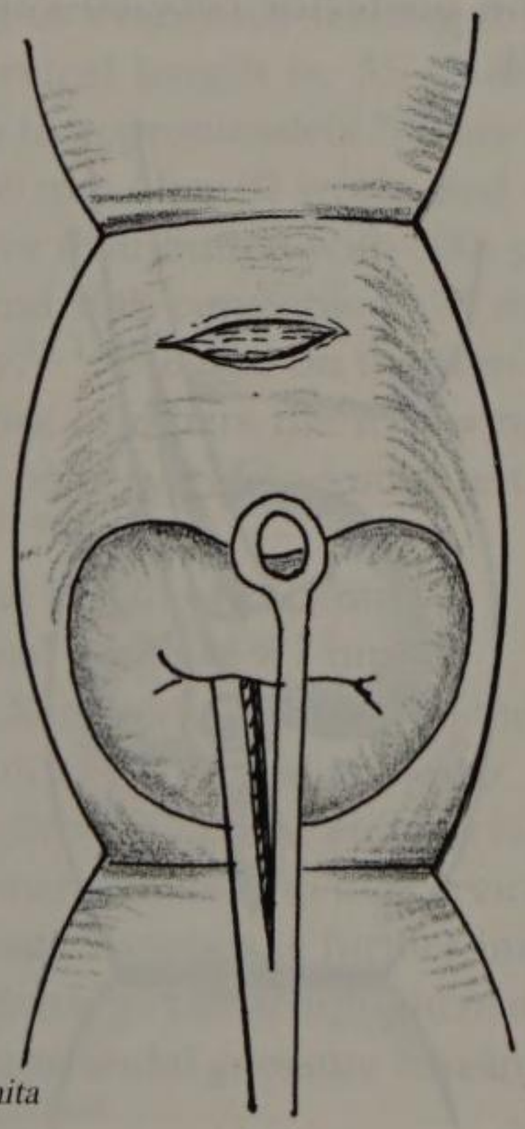

Fig. 40.2: Shirodkar's procedure: Transverse incision at the anterior cervicovaginal junction

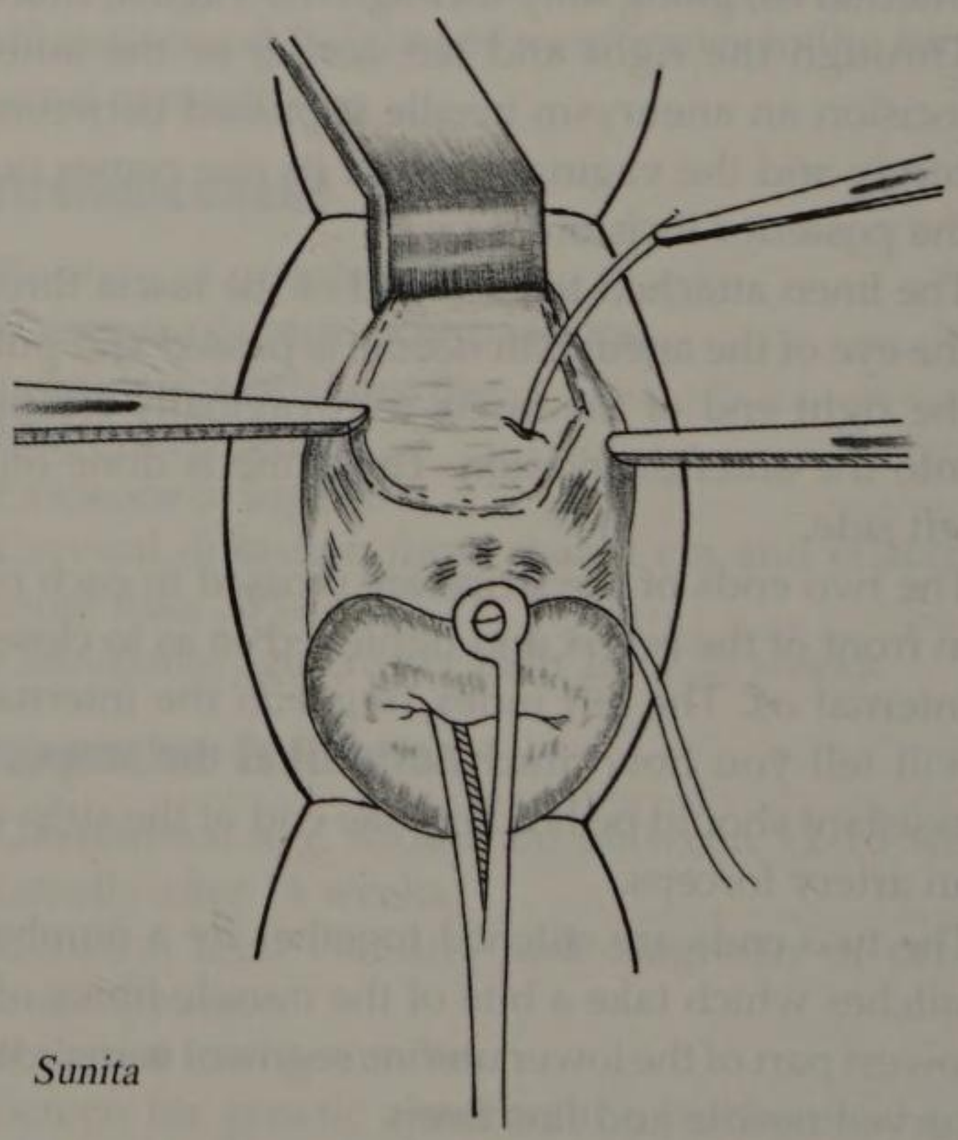

Fig. 40.4: Shirodkar's procedure: The threaded suture is pulled upwards to emerge anteriorly

11. This thread which is pulled forward is now mounted on a small round bodied Mayo needle which is made to take a bite of the musculature of the isthmus, a little above the level of the internal os (Fig. 40.5).
12. The same ligature carrier is inserted in the posterior incision and worked forwards till it emerges medial to the right pillar of the bladder and the suture which is previously mentioned to have taken a bite of the isthmus is made to engage in the eye of the carrier (Fig. 40.6).
13. The ligature carrier is pulled backward and out of the posterior incision.
14. The two ends of the suture are tied posteriorly as a reef knot so that the cervix admits only the tip of a finger (Fig. 40.7).
15. The ends of the suture are cut one cm long
16. The posterior incision is closed but the ends of the suture are left hanging in the vagina (Fig. 40.8).
17. Anteriorly the mucosa is closed with 2-0 chromic catgut after ensuring adequate hemostasis (Fig. 40.9).

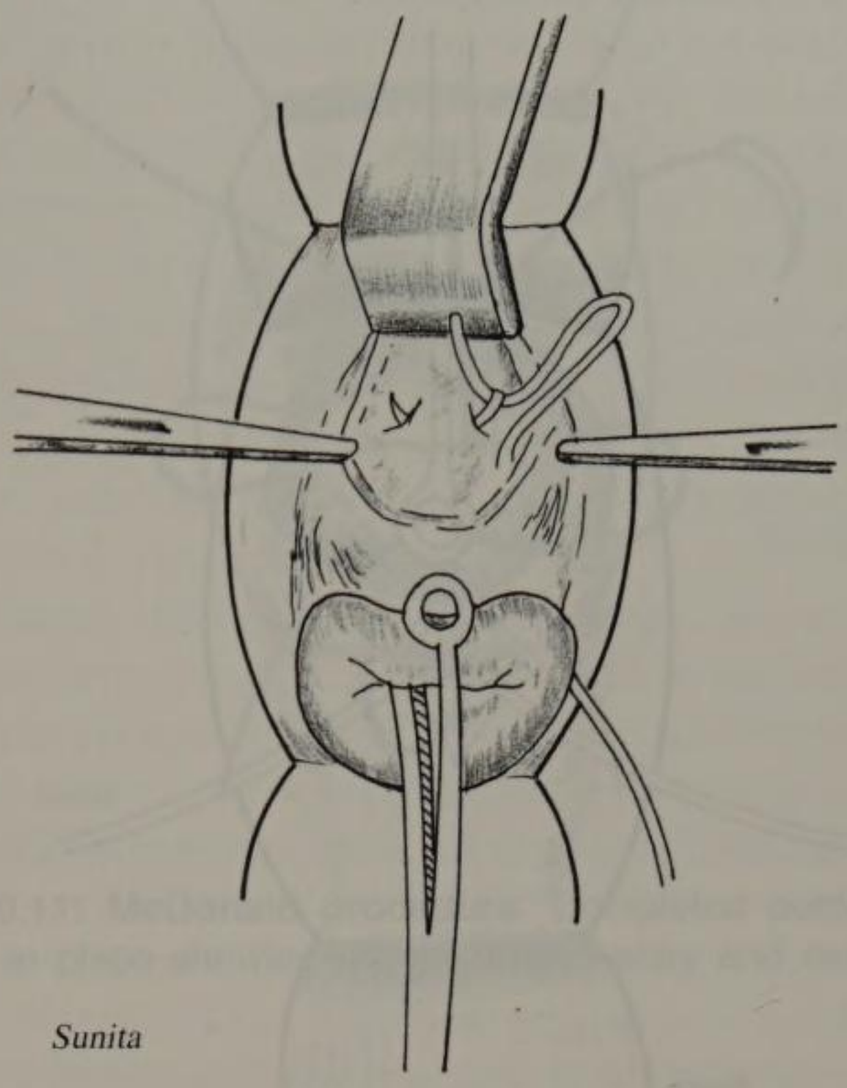

Fig. 40.5: Shirodkar's procedure: The suture brought out anteriorly is now mounted on a round bodied needle to take a bite of the musculature of the isthmus

Advantage

Suture is more proximal to internal os and hence is theoretically considered more effective

Disadvantages

1. Technically more difficult.
2. Higher occurrence of bleeding.
3. Increased risk of bladder and rectal injury as compared to McDonald suture.
4. Removal of suture is more difficult as the knot is buried.

McDonald's Cerclage

Principle

Placement of a purse string suture around the cervix at the cervicovaginal junction. It is preferably done under general anaesthesia although a spinal or even caudal anesthesia will suffice. Patient is placed in lithotomy postion with a 15° Trendelenberg tilt so that membranes and fetal parts are away from internal os. The external genitalia and vagina are prepared with betadine. The suture material used may be No. 1 or 2 double braided silk, No. 0 Nylon or merselene tape.

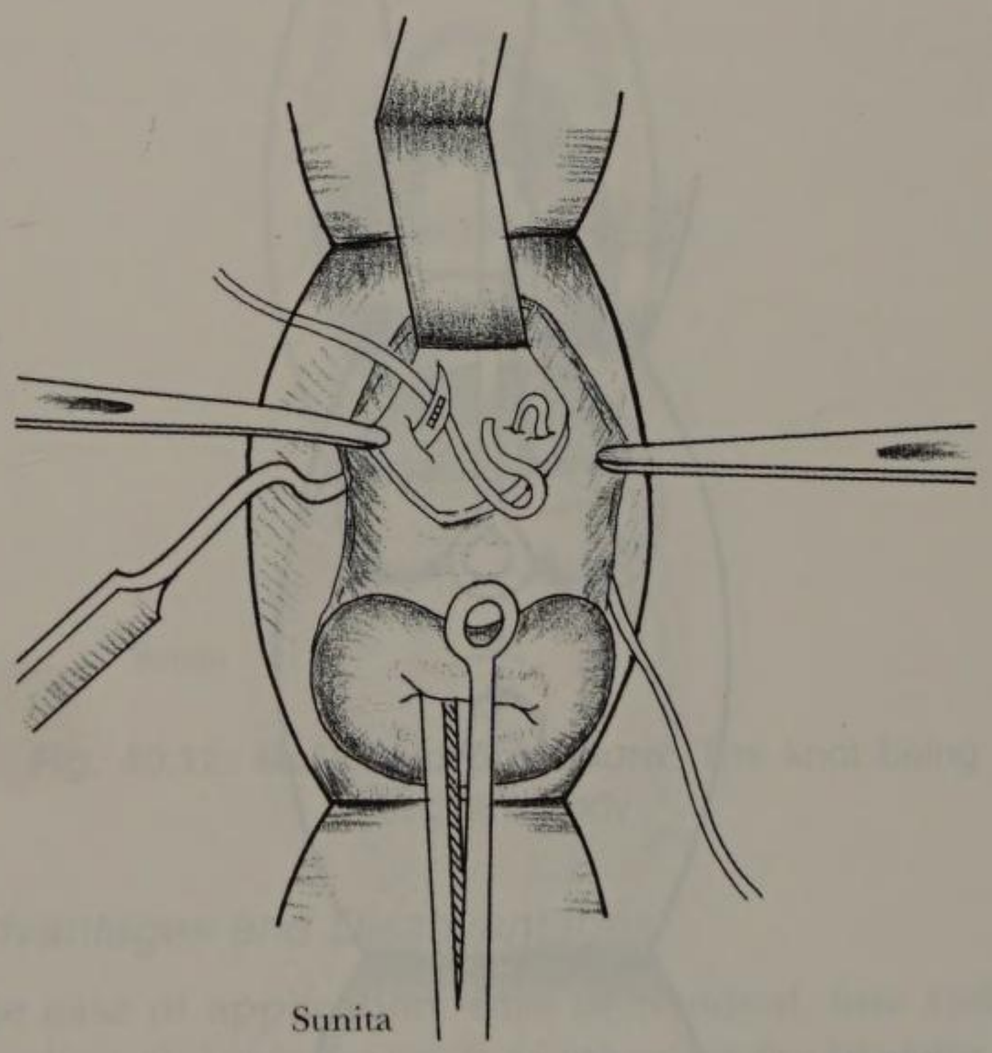

Fig. 40.6: Shirodkar's procedure: Shirodkar needle is inserted from posterior to anterior direction on the opposite side and eye of the needle is threaded with the suture which had taken a bite of the isthmus and the threaded needle is pulled back and brought out through the posterior incision

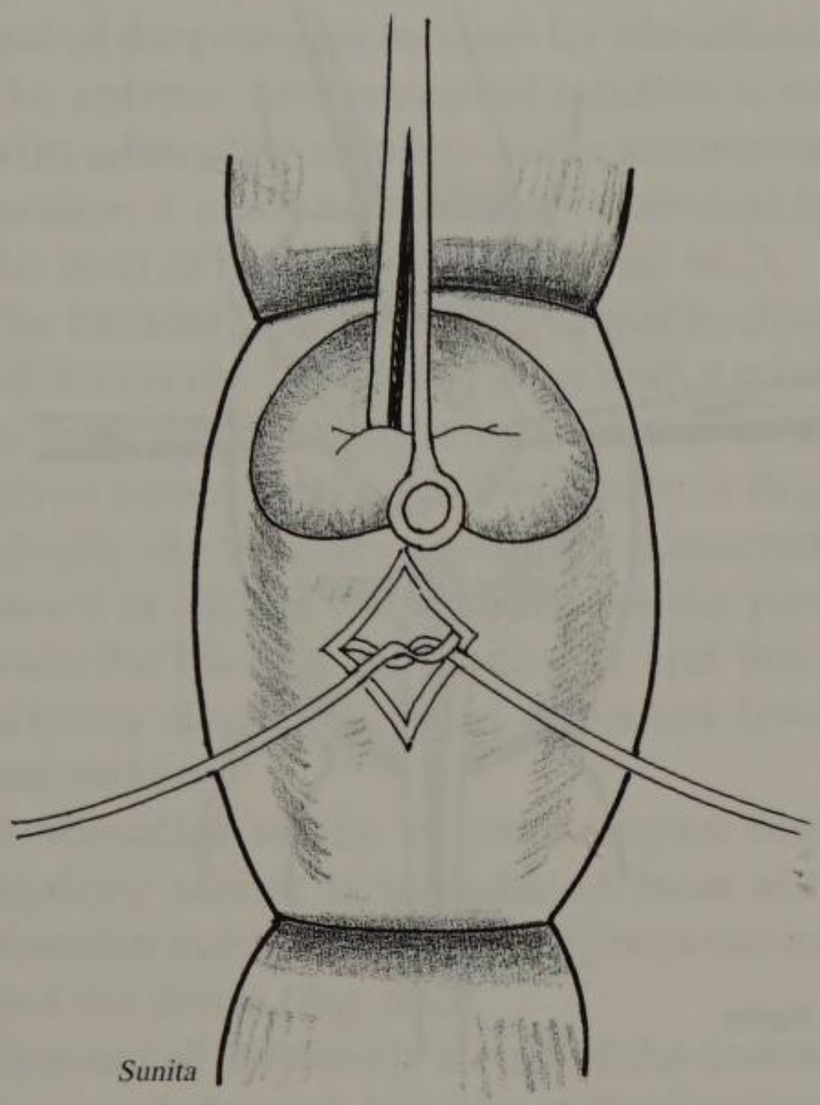

Fig. 40.7: Shirodkar's procedure: The two ends of the suture are tied posteriorly as a reef knot

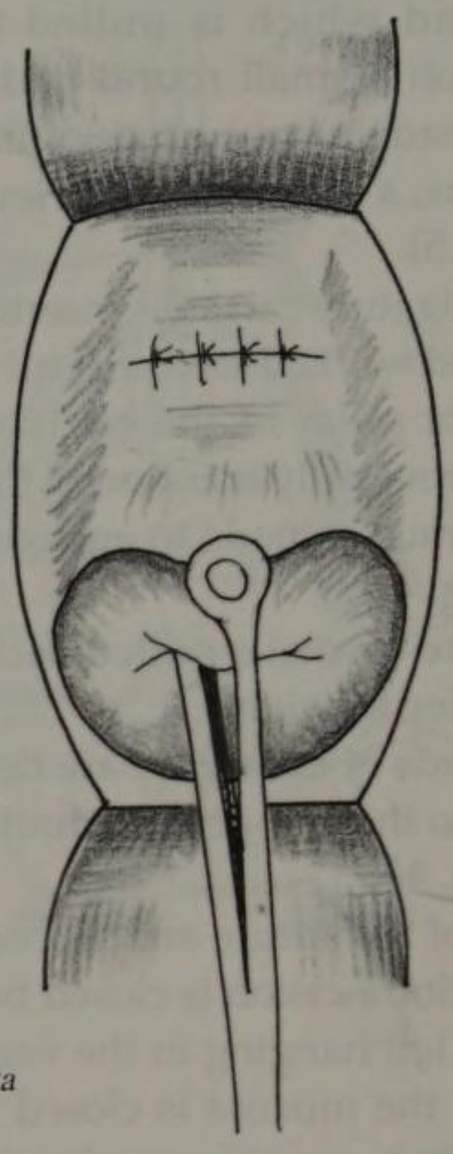

Fig. 40.9: Shirodkar's procedure: Anteriorly the vaginal mucosa is closed with 2-0 chromic catgut

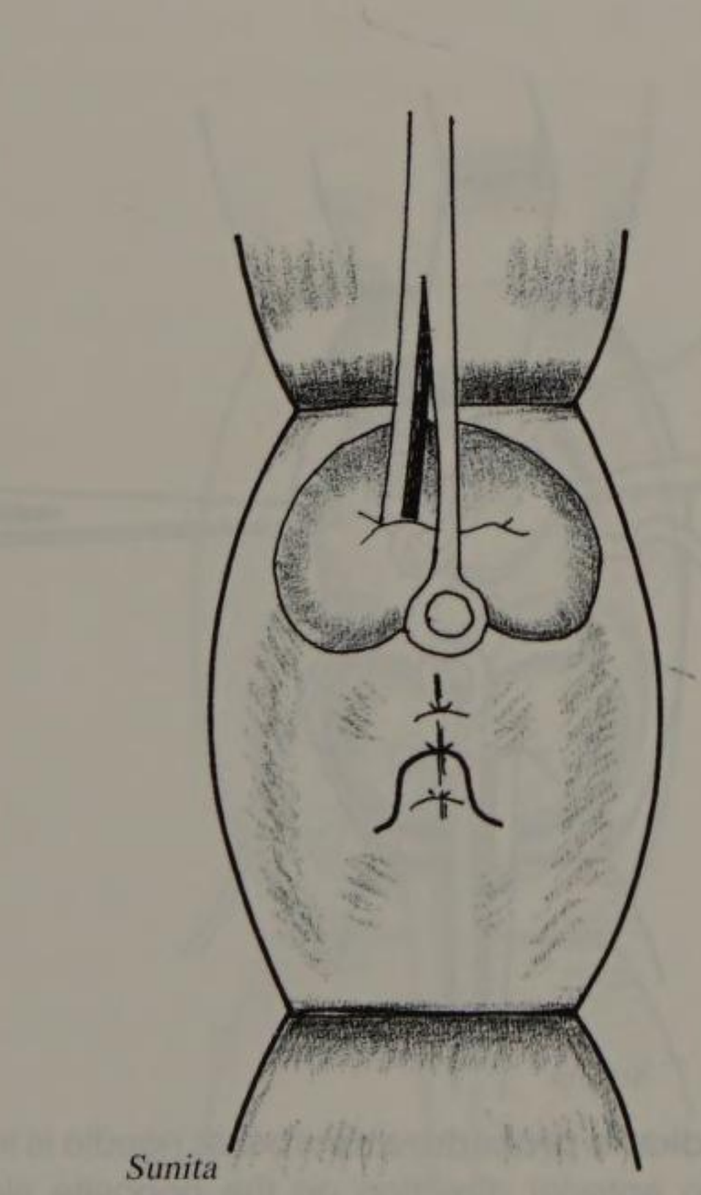

Fig. 40.8: Shirodkar's procedure: The posterior incision is closed with interrupted 2-0 catgut stitches but the ends of the Shirodkar's suture are left hanging in the vagina

Technique as Originally described by McDonald[3]

The bladder having been emptied, the cervix is exposed and grasped at each quadrant by Allis or Babcock forceps.If necessary the bulging bag of membranes is reduced by one or two dampened swabs held on sponge forceps. A purse string suture No. 4 Mersilk on a Mayo needle is inserted around the ecto-cervix as high as possible to approximate the level of the internal os. This is at the junction of the rugose vagina and smooth cervix. Five or six bites with the needle are made, with special attention to the stitches behind the cervix. These are difficult to insert and must be made deep. If the ligature pulls out later, it is always from this portion, the silk remaining attached to the anterior lip. The stitch is pulled tight enough to close the internal os, the knot being made in front of the cervix and the ends left long enough to facilitate subsequent division."

Following are the detailed steps describing the entry and exit points of the purse string suture:[11]

1. Posterior vaginal wall is retracted with Sim's speculum.
2. Anterior and posterior lips of the cervix are held separately with a ring forceps (sponge holder).
3. Large half circle round bodied needle is threaded with double No 1 silk.

4. Purse string suture is introduced through the substance of the cervix beginning anteriorly at the cervicovaginal junction at 12 o'clock position (Fig. 40.10).
5. This suture is brought out at 10 o' clock position, entering at 8 o'clock and exiting at 6 o' clock and re-entering at 6 o' clock.
6. The needle is then brought out at 4 o' clock,entered at 2 o' clock and finally back at 12 o' clock position (Fig. 40.11).
7. At no point of time should the suture penetrate the cervical canal.
8. All bites should be in the substance of the cervix at the cervicovaginal junction.
9. With this purse string suture now in place, the assistant is asked to keep one finger in the cervical canal and the two ends of the suture are tightened such that the internal os does not admit more than tip of finger.
10. The knot is tied anteriorly and the suture is cut one cm long (Fig. 40.12).

Some operators prefer a posterior knot instead. In that event the starting of the suture has to be from 6 o' clock. Occasionally when the cervix is very short, a first purse string suture can be used for traction to facilitate placement of second suture higher up at the correct site.

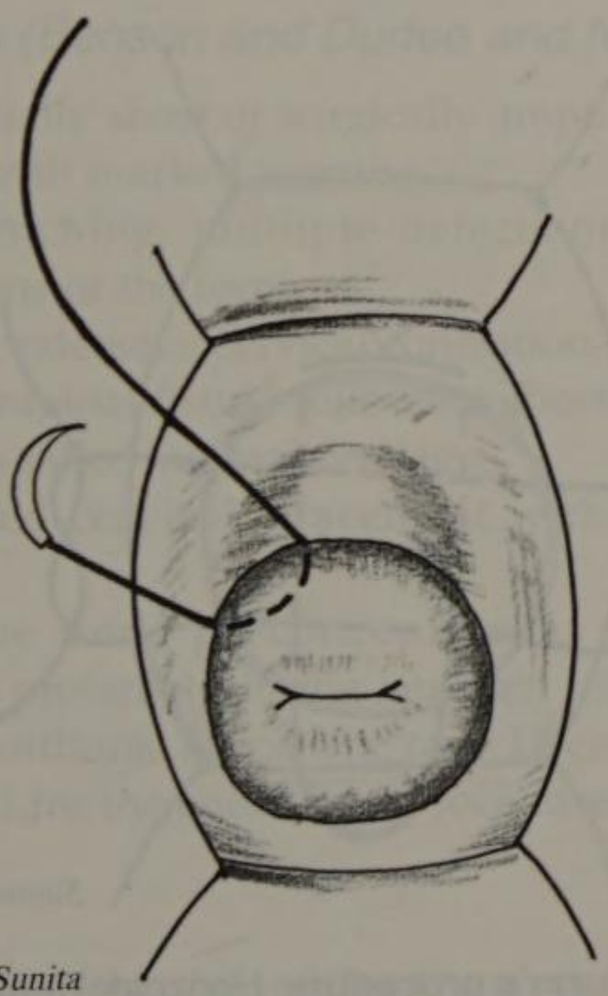

Fig. 40.10: McDonald procedure: Purse string suture is introduced at the cervicovaginal junction beginning anteriorly at 12 o' clock position and is brought out at 10 o'clock position

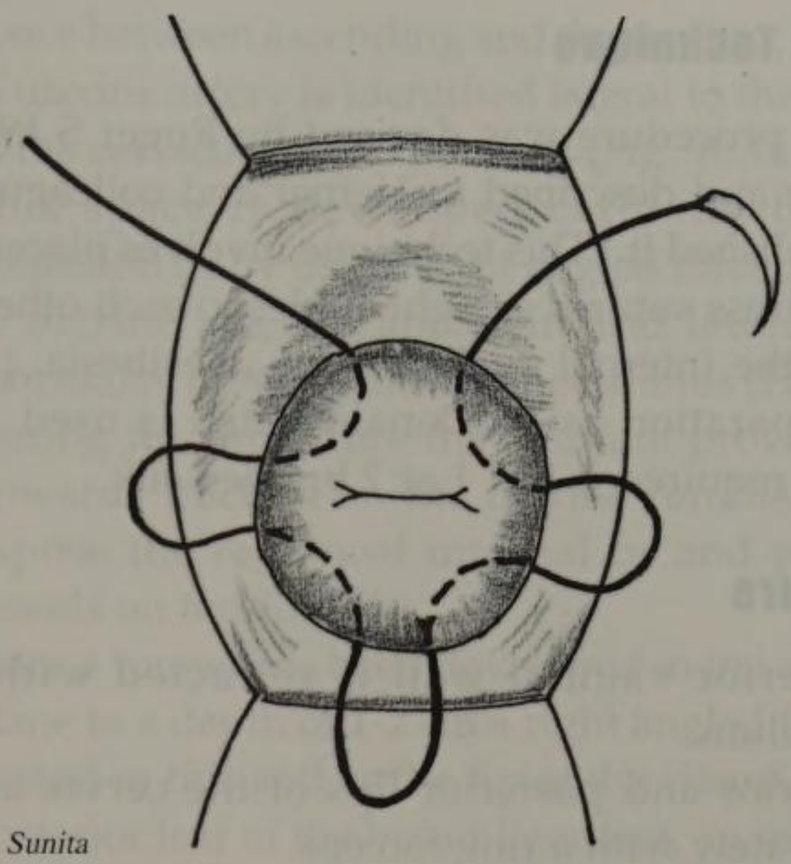

Fig. 40.11: McDonald procedure: Completed purse string suture in place showing the sequential entry and exit points

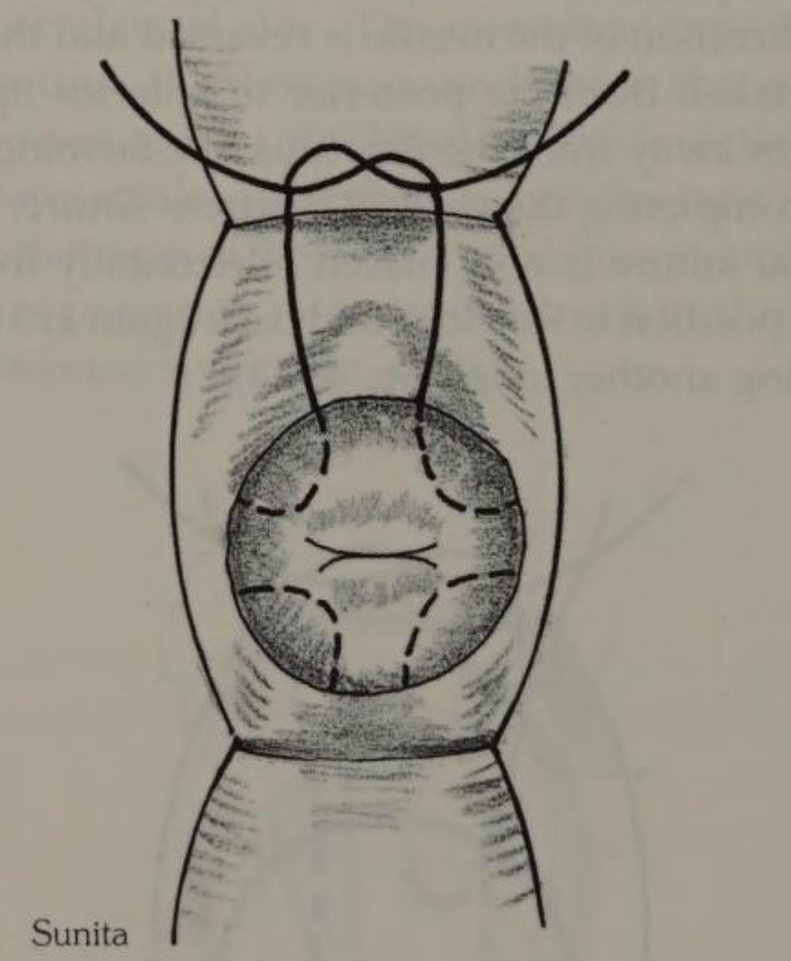

Fig. 40.12: McDonald procedure: The knot being tied anteriorly

Advantages and Disadvantages

The ease of application, ease of removal, low risk of bleeding and minimal risk of injury to the bladder are advantages of McDonald's stitch over Shirodkar. The only disadvantage is that the placement may not be high enough at the true level of the internal os but results with both techniques are comparable. This is the reason why the simpler McDonald's stitch is more popular today.

Wurm's Technique

Wurm's procedure was devised by Roger S Wurm of Adelaide and described to Hefner and colleagues who later published it.[4] This technique involves placement of two mattress sutures at right angles to each other at the level of the internal os. The same anesthesia, position and preparation as McDonald stitch is used. Suture material required is No. 1 or 2 braided silk.

Procedure

1. Posterior vaginal wall is retracted with Sim's speculum.
2. Anterior and posterior lips of the cervix are held separately with a ring forceps.
3. Large half circle round bodied needle is threaded with double No. 1 braided silk.
4. The first mattress suture is placed vertically starting from 12 o' clock position on the anterior lip to 6 o' clock position on the posterior lip (Fig. 40.13).
5. The direction of the needle is reversed and the bite is now taken from the posterior to anterior lip about one cm away from the previous bite forming a loop and completing the vertical mattress suture.
6. Similar suture is now placed horizontally from 3 o' clock position to 9 o'clock and back again at 3 o' clock forming another loop (Fig. 40.14).
7. The horizontal and the vertical mattress sutures are tied separately taking care at each step to avoid rupturing the membranes if exposed.

Wurm's suture is of value when the cervix is already dilated or effaced where Mc Donald or Shirodkar suture may cut through. It is a simple method of emergency cerclage closing the external os thus preventing the exposure of membranes into the vagina with minimal risk of bleeding.

EMERGENCY CERCLAGE

An emergency cerclage may be required in cases where a woman presents with dilated cervix and membranes protruding into the cervix or vagina. *It is mandatory to rule out uterine contractions, abruptio-placentae, leaking and chorioamnionitis before considering a case for emergency cerclage. It is also necessary to wait for 24 hours after admission and ensure that uterine contractions is not the cause of cervical dilatation.*

The most important step is reduction of the prolapsing membranes and the following techniques are recommended:

1. Steep Trendelenberg position.
2. Use of moist gauze or cotton to push the prolapsed membranes.
3. Use of Foley's catheter which is gently advanced into

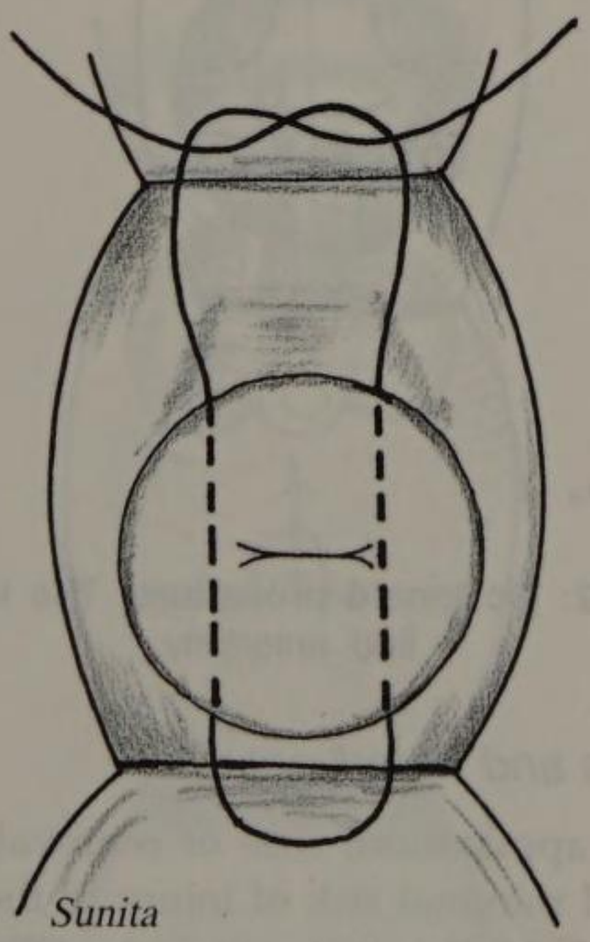

Fig. 40.13: Wurm's procedure: Vertical mattress is placed starting from 12 o'clock position on the anterior lip to 6 o'clock position on the posterior lip and back again from the posterior to anterior lip about one cm away from the previous bite forming a loop. Sutures are taken through the substance of the cervix

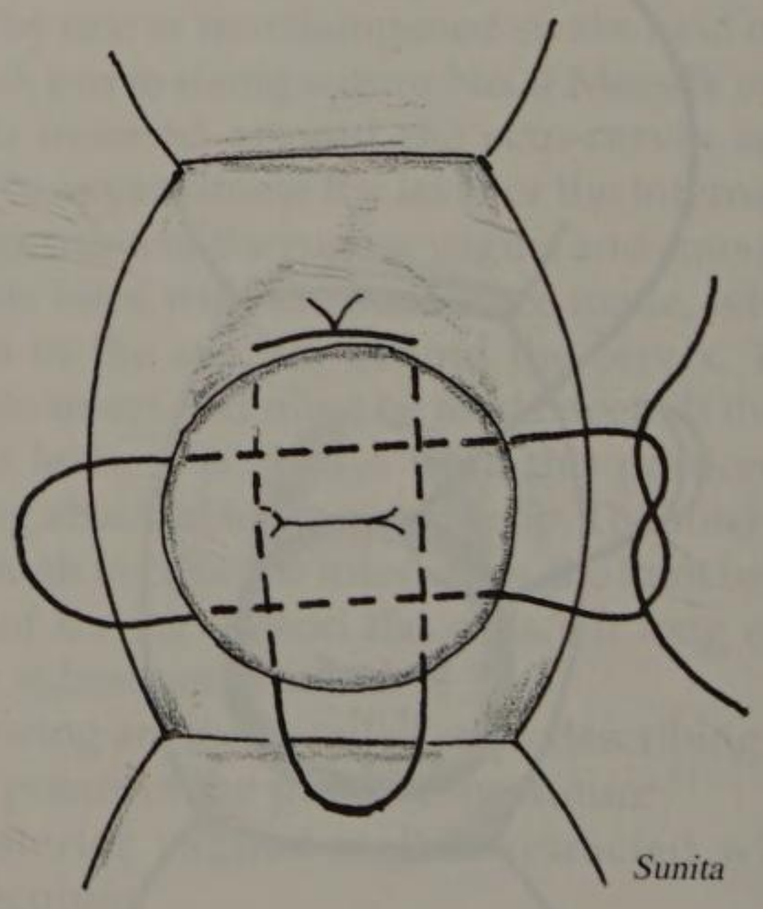

Fig. 40.14: Wurm's procedure: Horizontal mattress suture is placed starting from 3 o'clock position to 9 o'clock and back again to 3 o'clock forming another loop

the os below the membranes and then inflated with 30 ml saline which holds the membranes above the internal os and in the lower uterine segment. The balloon is deflated and removed after the cerclage is tied down.

4. Distension of the urinary bladder with 1-1.5 litres of normal saline too helps in displacing the herniating sac.
5. Tocolytics.
6. Amniocentesis to reduce the tension and allow retraction of the prolapsing hour glass membranes

After reducing the membranes a McDonald or a Wurm or a Shirodkar suture is put as described earlier. A stay suture may be needed for traction so as to enable the purse string suture to be placed high at the desired level.

TRANSABDOMINAL CERVICOISTHMIC CERCLAGE (TCIC)

The transabdominal approach to cerclage placement was first described by Benson and Durfee [5] and later popularized by Novy.[6]

Principle

Placement of suture above the cervix around the isthmus by transabdominal approach.

Indications (Benson and Durfee and Novy)

1. Congenitally short or surgically amputated cervix.
2. Cervix with marked scarring.
3. Deep notching, multiple defects or penetrating lacerations of the fornices.
4. Wide or extensive cervical conization.
5. Cervicovaginal fistula following abortion.
6. Previous failed vaginal cerclage.
7. Advanced cervical effacement with intact membranes.

It can be done preconception as well as post conception, preferably in the late first trimester under general anaesthesia. Merselene tape 15 cm long, 0.5 cm wide is used for the encerclage procedure.

Technique

1. Abdomen is opened by transverse or vertical incision.
2. Peritoneal reflection is divided transversely and bladder is pushed well down to approximately 5 cm (Fig. 40.15).
3. Space between ascending and descending branches of uterine artery is identified lateral to the isthmus at the cervico-vaginal junction (Fig. 40.16).
4. This space is developed carefully by blunt dissection or by using right angled forceps medial to uterine arteries and vein and lateral to the connective tissue of the uterine isthmus (Fig. 40.17).
5. During the procedure the assistant provides firm upwards traction on the uterine fundus so as to expose the region of internal os and place the vessels on tension.
6. Once a tunnel has been developed in the avascular plane to a depth of 1-2 cm a right angled forceps is passed in this and as the tip of the clamp tents the posterior leaf of the broad ligament, an incision or nick is made on the tip of the clamp and one end of the merselene tape is caught in the tip of the clamp and brought from posterior to anterior through this space (Figs 40.18 to 40.20).
7. An identical dissection is completed on the contralateral side. The merselene tape is passed around the isthmus and over the posterior peritoneum at the level of the insertion of the uterosacrals. The other end of the tape is caught with the tip of the right angled forceps and brought in a posterior to anterior direction through the dissected space (Fig. 40.21).

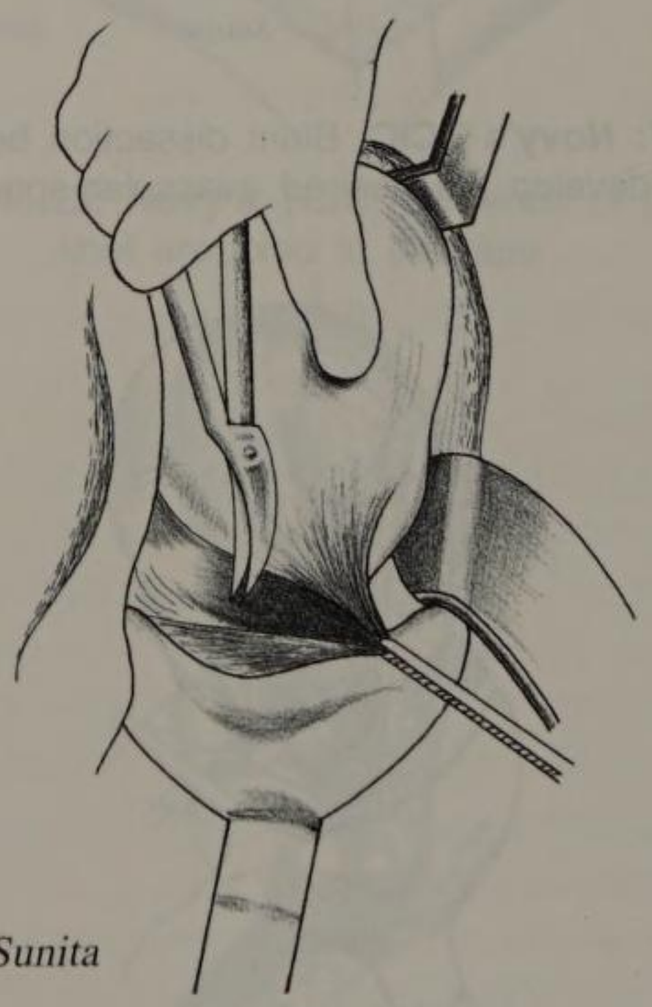

Fig. 40.15: Novy's TCIC: Uterovesical fold of peritoneum is incised transversely and bladder is pushed down

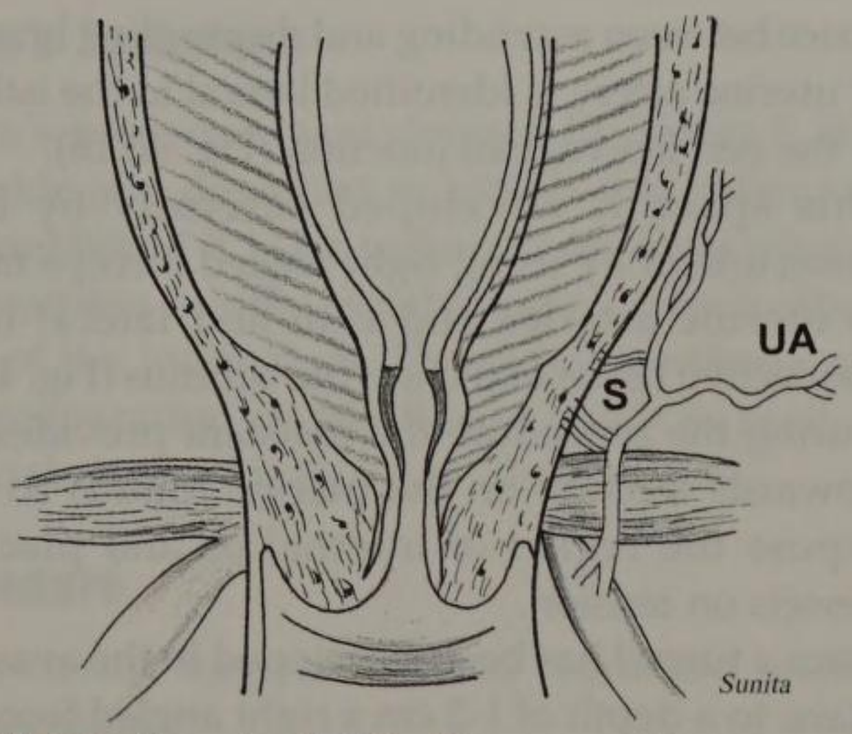

Fig. 40.16: Novy's TCIC: Diagrammatic representation showing the space (S) between the ascending and descending branches of uterine artery (UA) lateral to the isthmus at the cervico vaginal junction

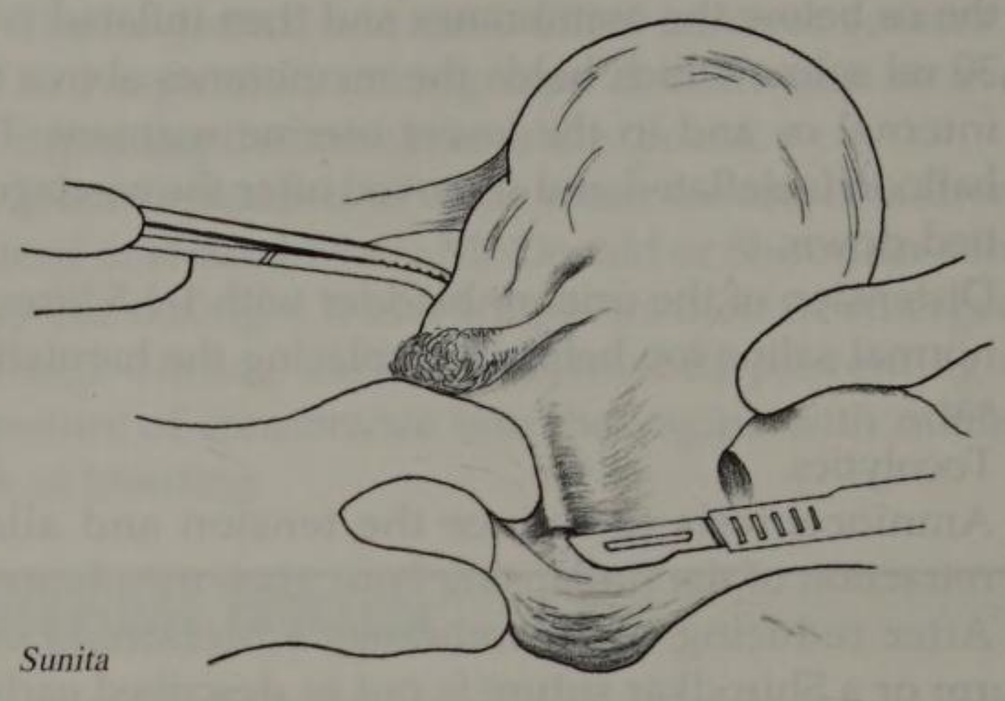

Fig. 40.19: Novy's TCIC: As the tip of the clamp tents the posterior leaf of the broad ligament, an incision or nick is made over it

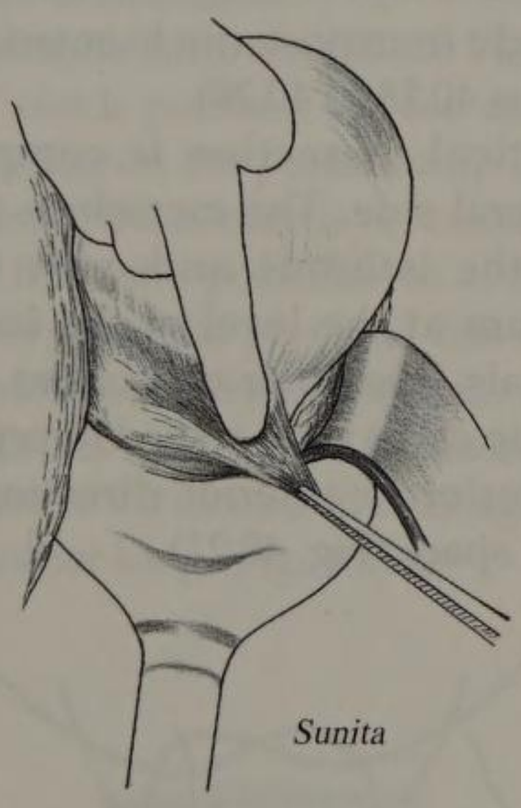

Fig. 40.17: Novy's TCIC: Blunt dissection being used to develop the desired avascular space

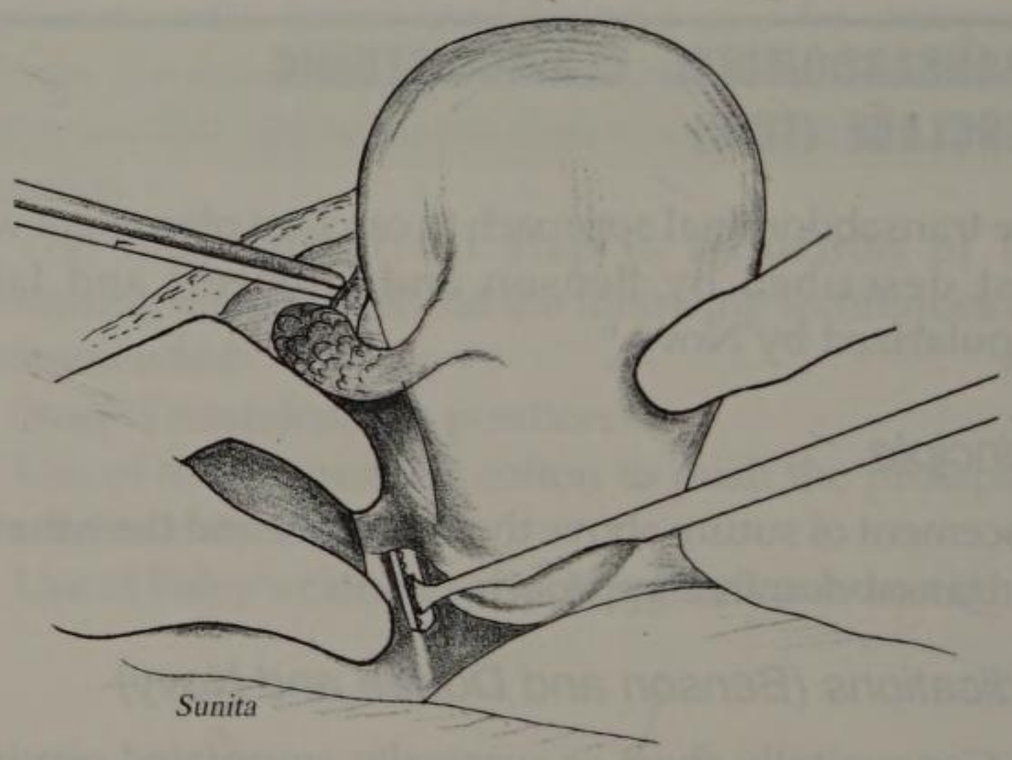

Fig. 40.20: Novy's TCIC: One end of the merselene tape is caught in the tip of the clamp which is now brought out in a posterior to anterior direction

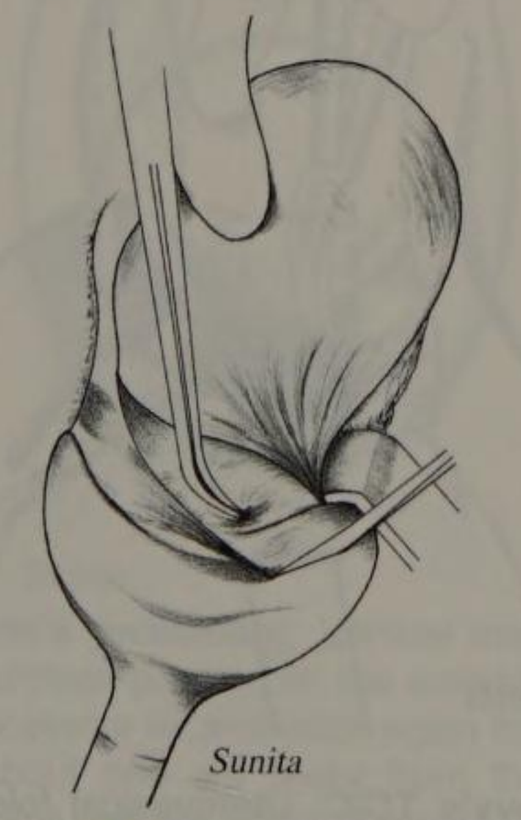

Fig. 40.18: Novy's TCIC: Right angled clamp is passed through the dissected space from anterior to posterior direction

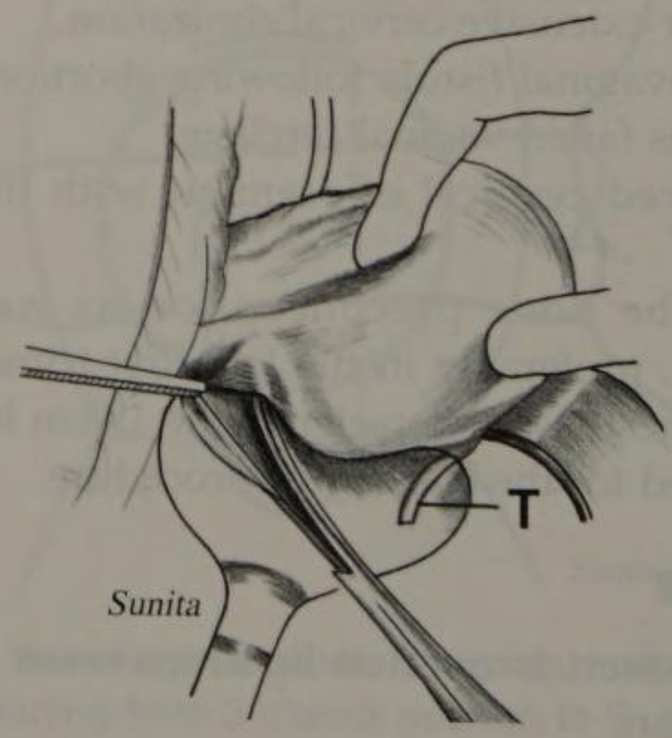

Fig. 40.21: Novy's TCIC: Similar dissection is completed on the contralateral side and the other end of the merselene tape is brought forwards through the dissected space anteriorly "T" depicts free end of the previously placed tape

8. The band is now in place around the isthmus and ready to be tied.
9. The merselene tape is secured anteriorly with a square knot taking care to keep the tape flat (Fig. 40.22).
10. Cut ends of the knot are fixed to the band by non absorbable suture (Fig. 40.23).
11. Bladder flap and abdominal incision are closed in layers.

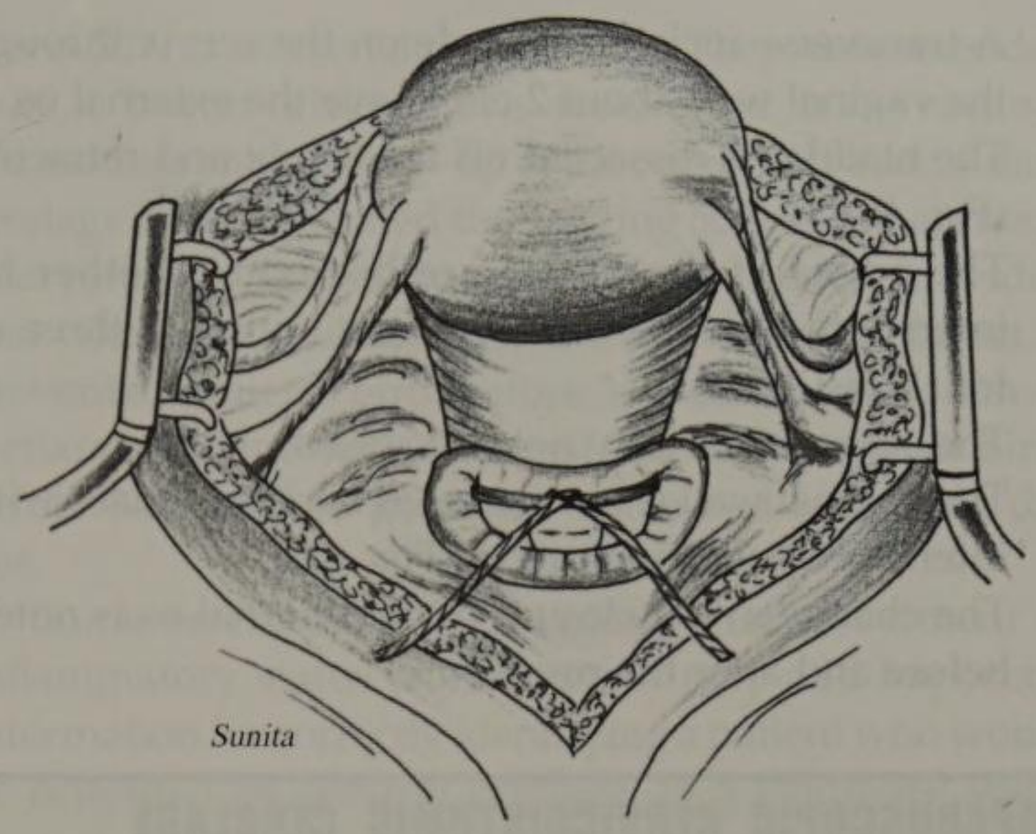

Fig. 40.22: Novy's TCIC: The merselene tape is secured anteriorly with a square knot

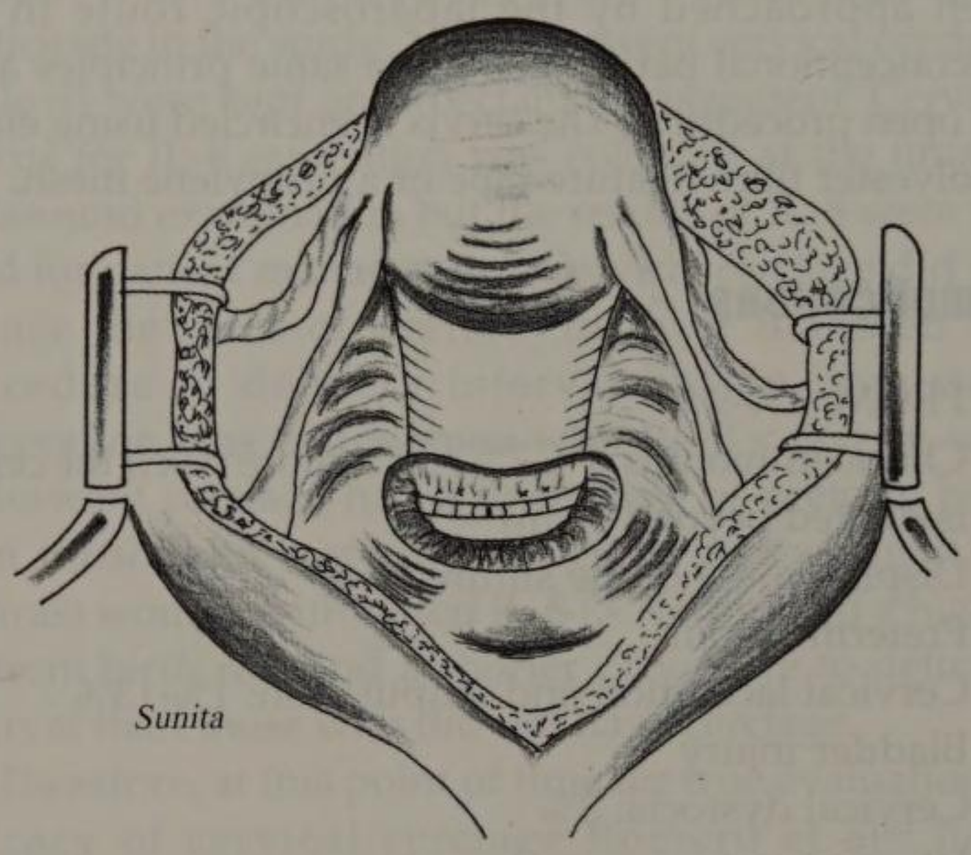

Fig. 40.23: Novy's TCIC: Cut ends of the knot are fixed to the tape

Mahran's Technique as Modified by Novy[26]

1. Abdomen is opened by transverse or vertical incision.
2. Peritoneal reflection is divided transversely and bladder is pushed well down to approximately 5 cm.
3. After the lower uterine segment is exposed, uterus is elevated out of the incision.
4. Uterine vessels are located by palpation between thumb and forefingers and are drawn laterally away from the uterine isthmus.
5. A 0.5 cm merselene tape loaded on a blunt tipped needle is passed from anterior to posterior on right side through the avascular space between retracted vessels and uterine isthmus without penetrating the myometrium.
6. The tape is passed above the uterosacral ligament.
7. Same procedure is repeated on the opposite side but needle enters from behind the uterus in an anterior direction.
8. The band should lie flat and snuggly and the knot is tied anteriorly with firm compression on the intervening tissue.

Advantages of Modified Technique

Novy's modification is simpler technically, easier to apply, avoids dissection in the lateral space and has less blood loss; the average blood loss in the original and modified techniques being 250 ml (75-450 ml) and 75 ml (50-200 ml) respectively.

Review of world literature has shown cumulative success rate of 89% (111 patients, 130 pregnancies) in the postconception period and a success rate of 81% (27 patients, 30 pregnancies) in the preconception period.[26]

LASH AND LASH PROCEDURE

Lash and Lash used a corrective procedure in the preconceptional period to repair an anterior cervical defect (Fig. 40.24) which they believed to be the cause of cervical incompetence.[1]

Fig. 40.24: Lash and Lash procedure: Diagram showing an anterior defect in the cervix

1. A transverse incision is made on the cervix through the vaginal wall about 2 cm above the external os.
2. The bladder is dissected off the cervix and retracted (Fig. 40.25).
3. The edges of the defect are brought together by interrupted No. 2 chromic catgut sutures (three or four) (Fig. 40.26).
4. The scar may or may not be excised.
5. The vaginal wall is now sutured back into place with interrupted chromic catgut (Fig. 40.27).
6. The change in the closure of the internal os is noted before and after the procedure.

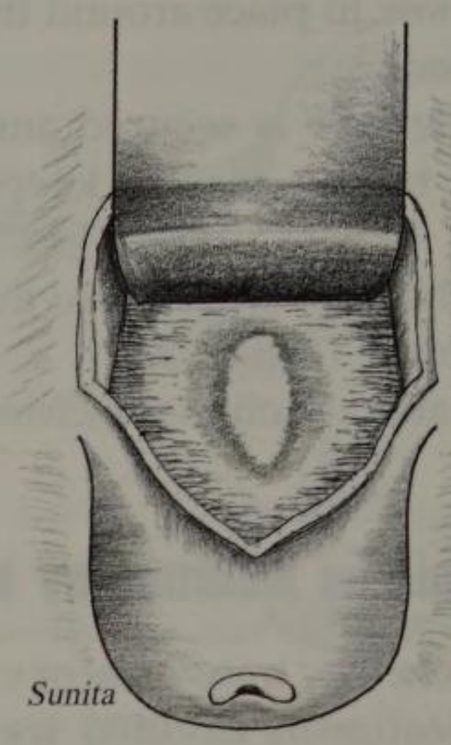

Fig. 40.25: Lash and Lash procedure: The dissected bladder is retracted upwards and anterior cervical defect is visualised

LAPAROSCOPIC CERVICOISTHMIC CERCLAGE

The transabdominal cervicoisthmic cerclage has recently been approached by the laparoscopic route in the preconceptional period using the same principles as in the open procedure.[7] The cervix is encircled using either a polyester fibre ligature tape or a propylene mesh.

Complications

1. PROM: 1%-9%
2. Chorioamnionitis: 1%-7% (30 % more risk if the cervix is dilated beyond 3 cm)
3. Displacement of the suture
4. Preterm labour
5. Cervical laceration and amputation: 1%-13%
6. Bladder injury
7. Cervical dystocia: 3%
8. Uterine rupture.

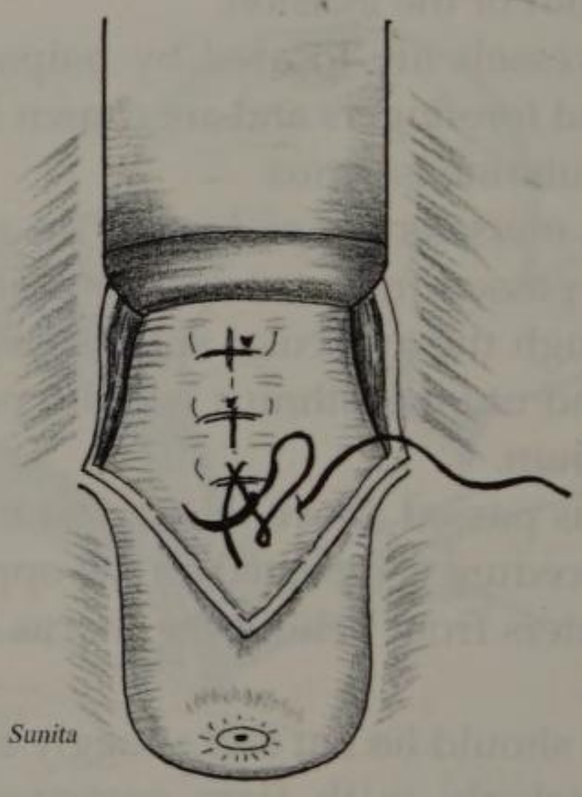

Fig. 40.26: Lash and Lash procedure: The edges of the defect are stitched together with interrupted No. 2 chromic catgut sutures

Postoperative Care

1. Postoperative hospitalization: Usually an overnight or a daycare stay is needed in cases of a vaginal cerclage and a stay for 2-3 days in cases of trans-abdominal procedure. Application of an emergency cerclage on the other hand may require a longer duration of hospitalization.
2. Use of antibiotics or tocolytics is a matter of individual choice. Both usually are preferred in an emergency cerclage.
3. It is advisable to observe pelvic precautions: Avoid heavy work and coitus and report to the doctor if discharge, bleeding, leaking or pain occurs.
4. Ultrasonography is a good modality to follow-up these patients for the detection of cervical changes.

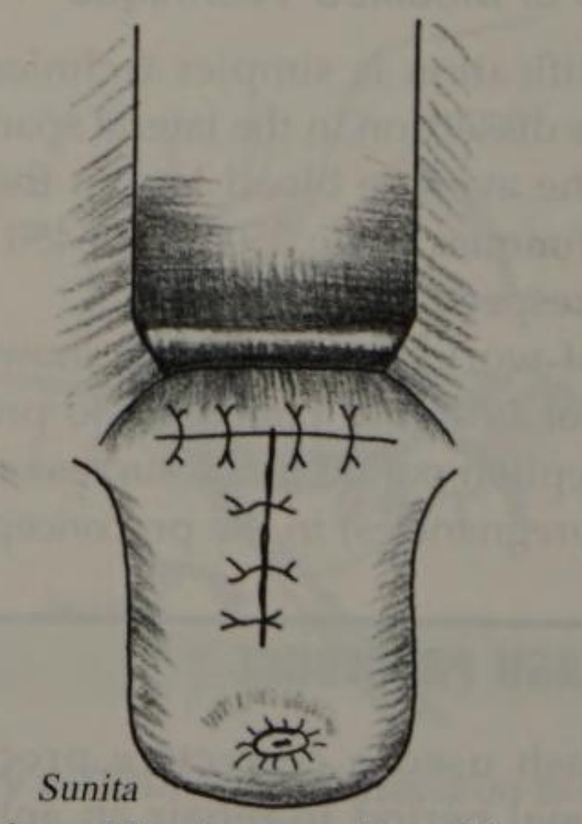

Fig. 40.27: Lash and Lash procedure: The vaginal wall over the defect is sutured back into place with interrupted chromic catgut sutures

Efficacy of Cervical Cerclage: Emerging Controversies

Shirodkar, in the last century, achieved a success rate of 85% using cervical cerclage in women with midtrimester losses when bed rest, hormones or other modalities could not prevent the loss. He could prove the existence of weakness of sphincter by repeated per vaginum examinations. Later, McDonald too reported a 73 % success rate for similar indications.

Fifty years down the line cervical encerclage is being used for a different indication: *"the prevention of preterm birth,"* therefore it is now that controversies are emerging about its efficacy for this new indication. Also in an era of Randomized Control Trials (RCT) for studying the effectiveness of a procedure all published results have to be analyzed in this context.

Cochrane review (2003) analyzed 6 RCT's to study the effectiveness of cervical cerclage[27] Prophylactic cerclage was compared with no cerclage in four trials. There was no overall reduction in pregnancy losses with a small reduction in preterm birth before 33 weeks (RR 0.75, 95% CI = 0.58-0.98) in the largest trial. Two trials examined the role of therapeutic cerclage when ultrasound revealed a short cervix. Pooled results failed to show a reduction in total pregnancy loss, early pregnancy loss, preterm birth (28-34 weeks) in women assigned to cervical cerclage. However, cervical cerclage was associated with pyrexia, increased tocolytic therapy and hospital admission but no serious morbidity.

Meekai To et al[28] in a large muticentric trial involving 47,123 women randomized those with a cervical length <15 mm to receive cervical cerclage or expectant management and found that the proportion of preterm births < 33 weeks was not statistically significantly different in cervical cerclage versus the expectant manangement group (22% vs 26 %, RR =0.84, 95% CI= 0.54-1.31). Also there was no significant difference in perinatal, maternal morbidity and mortality.

Althuisius et al[29] again reviewed all published trials on the efficacy of cervical cerclage in three scenarios: Primary or prophylactic cerclage where a woman is presumed to be at high risk for pregnancy losses based on past obstetric history, Secondary cerclage group where a cerclage is put after detection of cervical changes on ultrasound (short cervical length) and a tertiary cerclage where the procedure is used when the membranes are exposed into the vagina. The authors observed that although primary cerclage prevented shortening of the cervix 50% of women did not need it. They recommended that a better alternative would be transvaginal ultrasonographic follow-up of the cervix and a secondary cerclage when indicated thus saving 50% of unnecessary interventions. Secondary cerclage with bed rest provided that when the indication for the cerclage was correct, it prevented preterm birth before 34 weeks of gestation. A tertiary cerclage with bed rest reduced preterm birth before 34 weeks of gestation while bed rest alone did not.

Some recent evidence suggests that assessment of inflammatory status of endocervix may add important information for correctly identifying a patient who would be benefited by cervical cerclage. In a landmark study by Sakai et al on 16508 women with a singleton pregnancy, short cervix < 25 mm was seen in 252 women.[30] Two hundred forty-six women agreed to participate in the study, 165 underwent cervical cerclage while 85 were kept on expectant management. Cervical mucus for IL-8 estimation was collected at the time of ultrasound examination but the results of IL-8 were not used for patient management. Cervical cerclage did not reduce the rates of preterm birth or lengthen the procedure to delivery interval but an important observation was that women with IL- 8 < 360 ng who underwent cerclage had a lower rate of preterm birth than those who were on expectant management. In contrast women with raised IL-8 (> 360 ng) had a higher preterm birth rate and a shorter procedure to delivery interval than those who did not have cerclage.

Therefore, at this point of time for true evaluation of efficacy of cervical cerclage Romero et al[31] have recommended that the procedure be used in a woman who rightly needs it namely,, previous history of mid trimester losses or preterm birth alongwith sonographic evidence of a short incompetent cervix and absence of endocervical and vaginal inflammation. This would perhaps identify a patient who has a **"true cervical disease."** It was this very indication for which Dr. Shirodkar professed the cerclage.

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Section VII

Non-Descent Vaginal Hysterectomy

41

Basic and Clampless Techniques

Shalini Rajaram, Neerja Goel

INTRODUCTION

Hysterectomy is the commonest procedure performed in gynecology. Traditionally various routes for removal of the uterus have been used. Abdominal hysterectomy is undoubtedly the most popular with a 70: 30 ratio for abdominal versus vaginal route.[1,2] Laparoscopic assisted vaginal hysterectomy (LAVH) enjoyed its place in the last decade when it had become fashionable to perform a hysterectomy with the technically superior laparoscope. However, gynecologists were soon to learn that hysterectomy could be performed more easily, faster, with least complications and with excellent patient recovery when the vaginal route was used. In fact revival of this route must be attributed to the widespread use of the laparoscopic approach. Anyone who has performed LAVH will agree that majority of the procedure is accomplished vaginally! In fact some gynecologists condemn LAVH as a dangerous and unnecessary operation that is often substituted for vaginal hysterectomy.[2] The latest randomized eVALuate study to evaluate the role of Vaginal, Abdominal and Laparoscopic hysterectomy in routine gynecological practice concluded that major hemorrhage, hematoma, ureteric injury, bladder injury and anesthetic complications were more in the LAVH group when compared to abdominal and vaginal hysterectomies.[3] In addition LAVH was accomplished in twice the time needed for a vaginal hysterectomy; 72 minutes versus 39 minutes.

Despite documented evidence that the vaginal route is superior, why is it that gynecologists shy away from the vaginal route? Is it because abdominal hysterectomy with its large incision and easy access to the uterus is surgically more comfortable or is it because of physician's reluctance to change or is it because of inadequate residency training? Kovac by the use of a statistical model in physician decision making showed that various factors such as residency training, personal experience, and surgical capability greatly influence the selection of abdominal versus vaginal hysterectomy. In their study they showed that physicians' seldom selected the vaginal route despite any clear indication for the abdominal route.[4] Current evidence suggests that a physician's comfort and preference is the only consideration in selection of the type of hysterectomy performed![5] This despite documenting that abdominal hysterectomy for less serious conditions unnecessarily subjects women to greater risk of complications, longer recuperation and poorer postoperative quality-of-life outcomes.

It can be rightly said that the father of non-descent vaginal hysterectomy in modern India is certainly Sheth with his experience of 5655 vaginal hysterectomies (VH) done from 1967 to 2001.[6] He did all hysterectomies, in private practice without laparoscopic assistance. A new concept proposed by him is the 'trial vaginal hysterectomy' where a surgeon feels that VH is possible but may prove difficult or fail and recourse to laparoscopy or laparotomy may be necessary. This puts the gynecologist in a comfortable position, as 'failures' can occur in certain situations like a large uterus, adnexal pathology, adhesions, etc. The technique requires only standard instruments and sutures and gaining expertise in NDVH would mean serving 80% of the world, i.e. developing countries better. Finally, Sheth believes that 'marketing' the procedure as 'scarless surgery' would make it more popular.

Non-descent vaginal hysterectomy is a more skilled procedure and has a learning curve, but nevertheless can be mastered provided the correct approach and

technique is adopted. This chapter addresses the technique in a 'step-by-step' approach and accompanying video of the basic and clampless technique will make the procedure simpler to understand and practice.

Indications and Contraindications

Non-descent vaginal hysterectomy is generally performed for benign indications. An indication of hysterectomy and absence of any contraindications to the vaginal route for hysterectomy are sufficient markers to perform vaginal hysterectomy (Table 41.1 and 41.2).

Basic considerations for performing a non-descent vaginal hysterectomy would be a good operative set-up, powerful theatre lights, additional spotlights, adequate anesthesia, proper instrumentation and correct patient position. In addition a comfortable operating chair (preferably with a backrest for the surgeon) and a rested, confident surgeon are all that are required to get started!

Instruments

All instruments and drapes are pre-packed and sterilized ideally in the central sterile supply department (CSSD). A detailed description of instrument sterilization procedures including the rapid technique is given in the chapter on sterilization techniques. A complete vaginal hysterectomy set should contain the instruments shown in Table 41.3 and Figure 41.1. Special instruments for non-descent vaginal hysterectomy are the cat's paw, self-retaining vaginal retractor and Auvard's speculum (Figs 41.2 to 41.4). Additional instruments needed for advanced techniques in a large uterus are described in the next chapters (42 and 43).

Table 41.1: Indications of non-descent vaginal hysterectomy

1. Dysfunctional uterine bleeding
2. Fibroid uterus
3. Adenomyosis
4. Chronic pelvic pain
5. Cervical dysplasia
6. Cervical polyp or fibroid

Table 41.2: Absolute contraindications of vaginal hysterectomy (VH)

1. Uterus more than 20 weeks' size
2. Previous vesico-vaginal or recto-vaginal fistula repair
3. Cervix flushed with vault
4. Adnexal pathology
5. Very limited vaginal space
6. Severely restricted uterine mobility
7. Poor per-operative score [7]

Table 41.3: Instruments for non-descent vaginal hysterectomy

Instrument	*Number*	*Size*
Sponge holders	3	-
Towel clips	6	-
Metal catheter	1	-
Bladder sound	1	-
Uterine sound	1	-
Large Sim's speculum	2	-
Volsellum	1	-
Small Dever's retractor	1	-
Right angled retractors	2	-
Knife handle(no:3)	1	-
Allis tissue forceps	8, 4	6″, 8″
Heaney's hysterectomy clamps	6	6″, 8″
Dissecting forceps (toothed)	1	6″
Dissecting forceps (non-toothed)	1	6″
Straight scissors	1	6″, 8″
Metzenbaum's curved dissecting scissors	1	6″, 8″
Needle holders	2	6″, 8″
Straight mosquito artery forceps	6	4″
Curved artery forceps	8, 8	6″, 8″

Special Instruments

Of the three special instruments the cat's paw with four teeth is an invaluable instrument used for grasping and applying traction on the cervix; it is indispensable in a non-descent vaginal hysterectomy (Figs 41.2 and 41.3).

Fig. 41.1: Vaginal hysterectomy set

Fig. 41.2: Cat's paw

Fig. 41.3: Cat's paw showing four grasping teeth

Fig. 41.4: Self-retaining vaginal retractor

Fig. 41.5: Auvard's speculum

The self-retaining vaginal retractor offers sufficient lateral space for working (Fig. 41.4) It may however be substituted by right-angled lateral retractors. The Auvard's speculum is a heavy instrument for retraction of the posterior vaginal wall (Fig. 41.5). Large, broad Sim's speculum may be used interchangeably.

Suture Material

Vicryl is the universal suture material used in all steps of non-descent vaginal hysterectomy except for closure of peritoneum where monocryl is used. Vicryl No.1 with a 40 mm ½ circle cutting or trocar pointed needle is used for Mackenrodt's/uterosacral ligament complex while a heavy round-bodied needle may be used for other pedicles. Vagina is closed with vicryl 1-0. Peritoneum is approximated with monocryl 2-0. Catgut should be avoided, as the tensile strength is variable, tends to break even with a standard pull and disintegrates rapidly in the presence of infection.

Operative Technique

Position of Patient

The lithotomy position with a 15 to 30 degree head-down tilt is good position for non-descent vaginal hysterectomy. It not only provides good access to the vagina but also moves the bowel away from the pouch of Douglas. The buttocks should be slightly over the edge of the table to facilitate posterior retraction without hindrance to instruments.

Step 1

After the labial sutures are applied bladder is drained with a metal catheter to ensure it is empty (Fig. 41.6). Figure 41.7 shows the posterior vaginal wall retracted with a Sim's speculum and showing no cervical descent.

Step 2

The cervix is held with the vulsellum (Fig. 41.8) and a transverse incision is made on the anterior vaginal wall, the incision deepened through the entire length with simultaneous traction on the cervix (Fig. 41.9). The subepithelial tissues can be seen retracting upwards. The incision is further deepened to cut the pubo-vesico-cervical ligament till the rough surface of the cervix is seen. While incising the pubo-vesico-cervical ligament the bladder is seen withdrawing upwards. 20 ml of 1in

Fig. 41.6: Metal catheter draining bladder

Fig. 41.7: Sim's speculum in place showing no descent

Fig. 41.8: Holding anterior lip of cervix with vulsellum

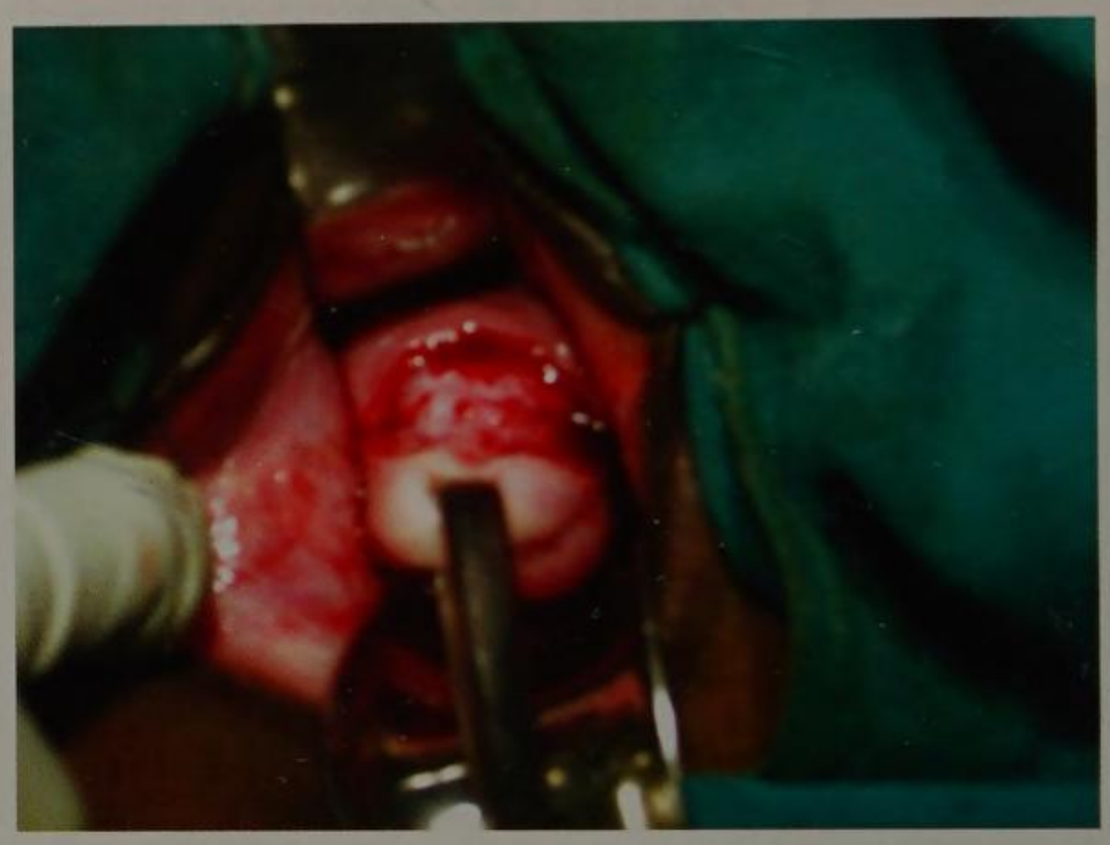

Fig. 41.9: Transverse incision on cervix

200,000 adrenaline (1 ampoule of adrenaline in 200 ml of saline) can be infiltrated in the line of incision to reduce bleeding and keep the operative field clear.

Step 3

The next step would entail pushing the bladder up using steady traction with a sponge on a holder until the shiny peritoneum of the uterovesical fold (UV fold) is visualized (Figs 41.10 and 41.11) and picked up with an artery forceps.

Step 4

The uterovesical (UV) fold of peritoneum is incised and the exposed surface of the uterus is visualized (Fig. 41.12). The incision is extended on either side and the Dever's retractor introduced (Fig. 41.13).

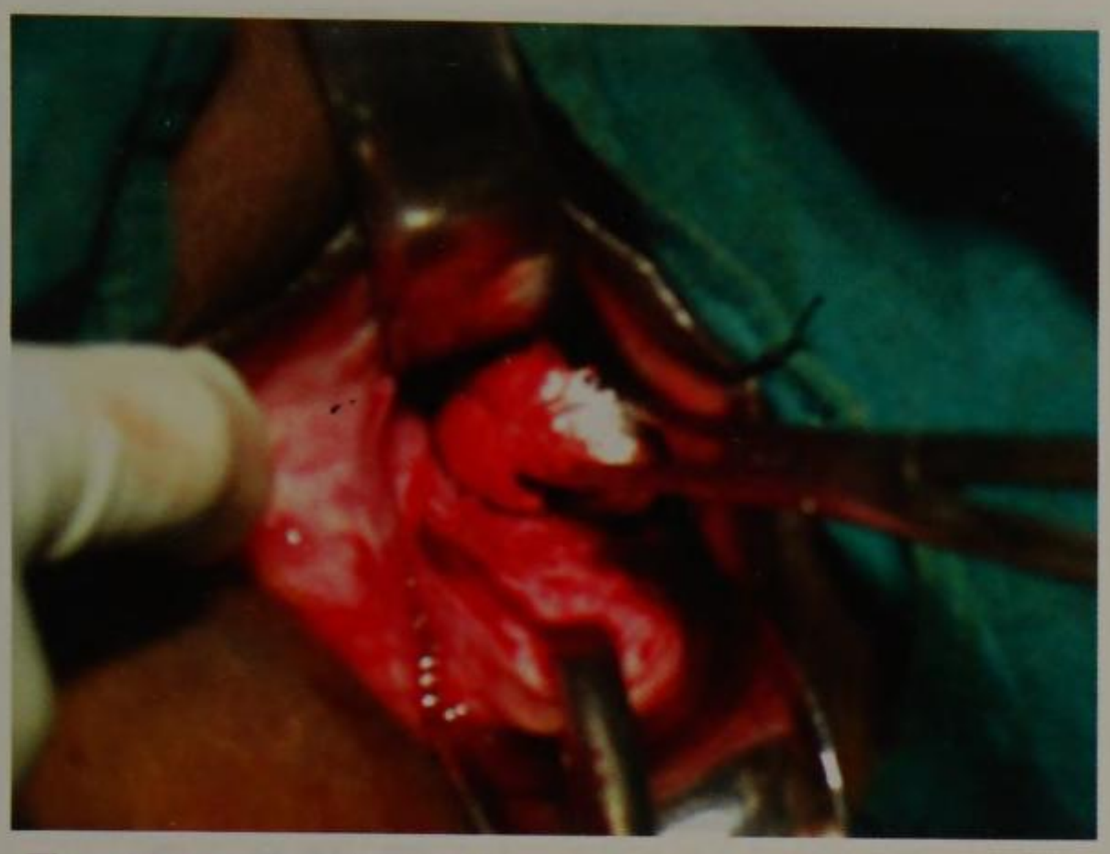

Fig. 41.10: Steady traction using a sponge on a holder and pushing bladder upwards

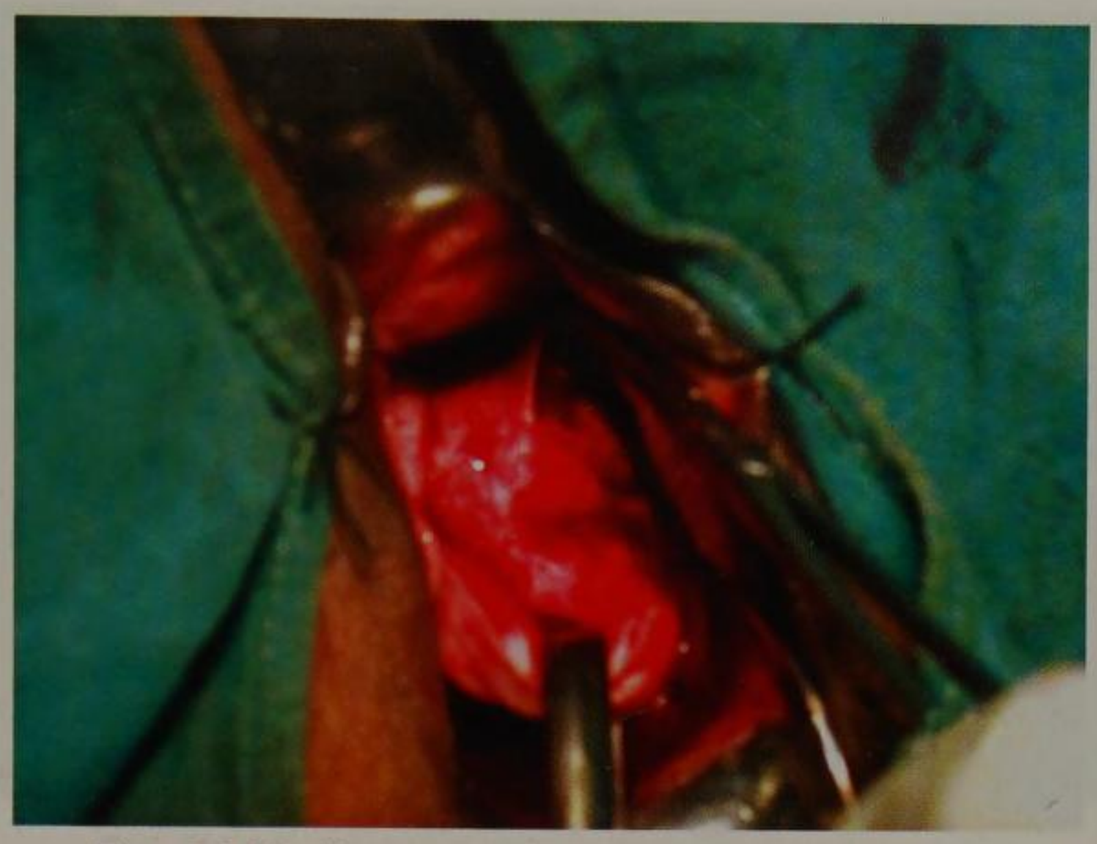

Fig. 41.11: Uterovesical fold of peritoneum lifted with artery forceps

Fig. 41.12: Incising UV fold of peritoneum

Fig. 41.13: Peritoneum held down to show anterior surface of uterus

Step 5

The next step consists of picking the loose fold of the posterior vaginal wall at the cervico-vaginal junction with the Allis tissue forceps and giving a bold incision to open the vagina and pouch of Douglas at the same time (Fig. 41.14). In the event that this does not happen the vagina is extended laterally on both sides to connect to the anterior vaginal incision. The loose fold of peritoneum is then dissected out gently in the midline with both index fingers before being incised (Figs 41.15 and 41.16).

Step 6

The vulsellum is now replaced with the cat's paw for grasping the cervix. The uterosacral-Mackenrodt's complex is then lifted with the index finger, clamped using a Heaney's hysterectomy clamp, cut, transfixed and ligated (Figs 41.17 to 41.19).

Step 7

The next step would be to secure the uterine vessels with the anterior and posterior folds of peritoneum, cutting and ligating without transfixing (Figs 41.20 and 41.21).

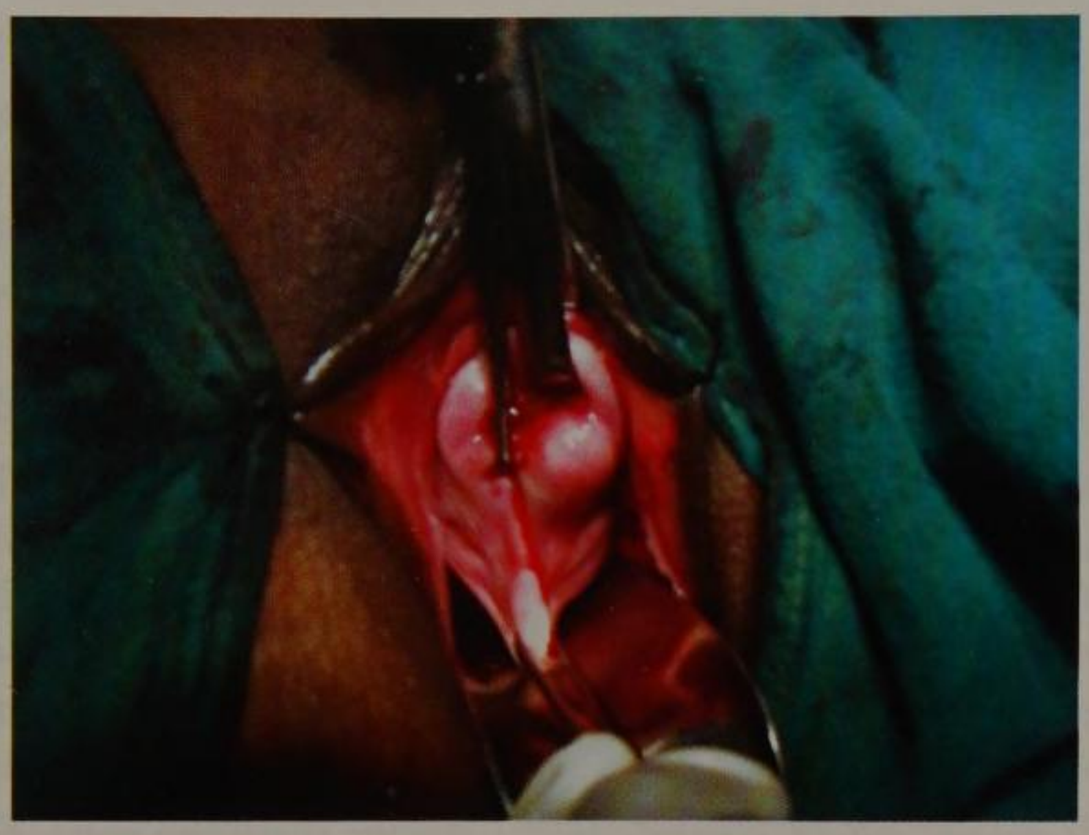

Fig. 41.14: Picking posterior vaginal wall with Allis tissue forceps

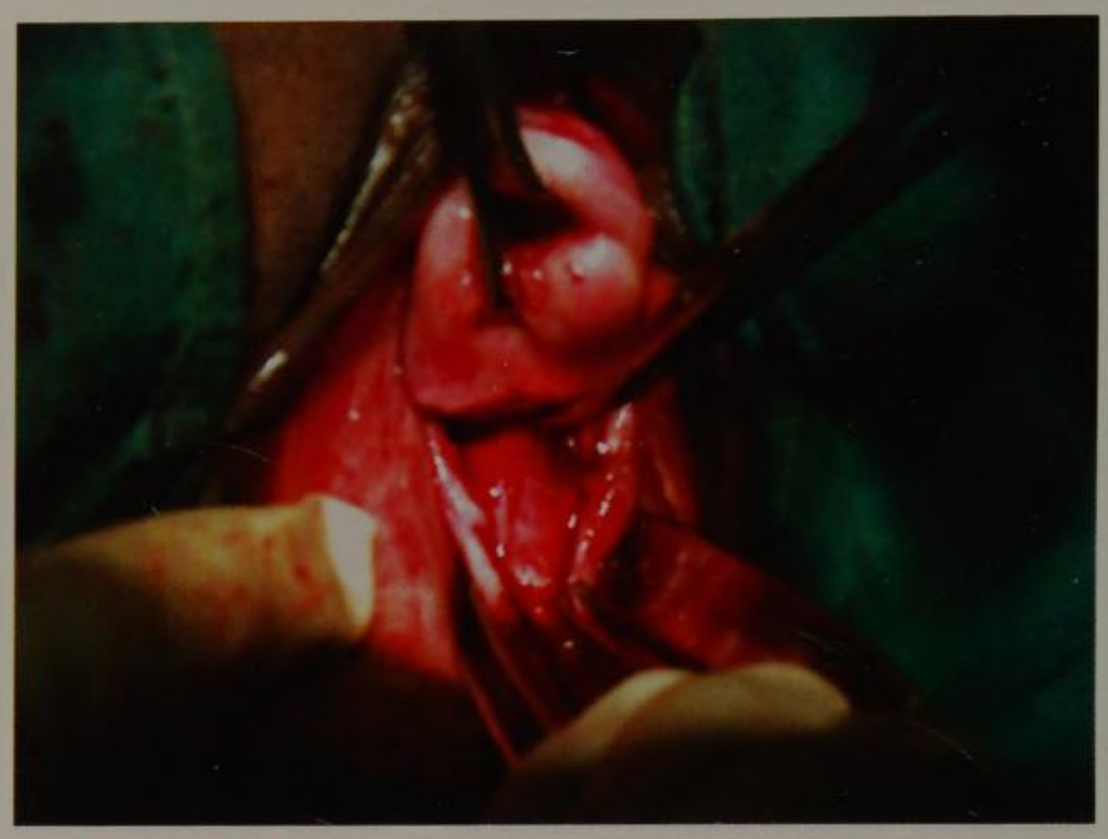

Fig. 41.15: Posterior fold of peritoneum lifted with artery forceps

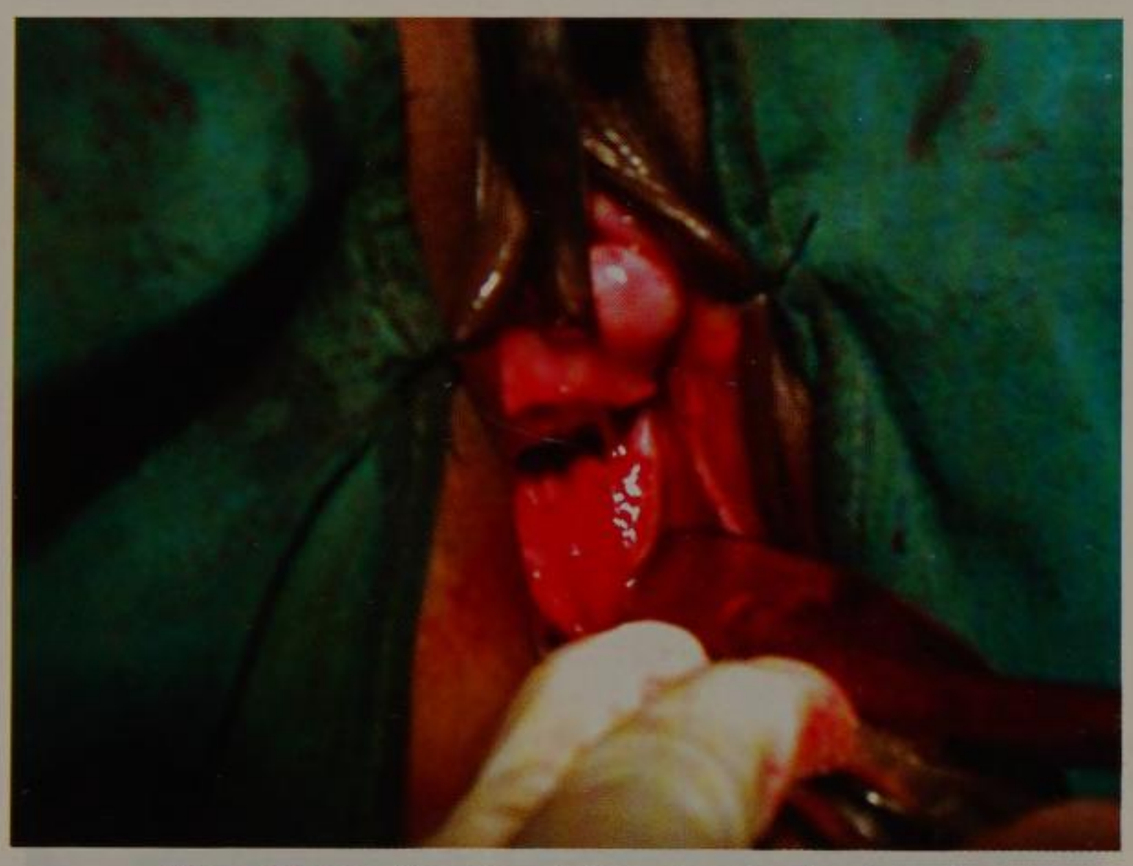

Fig. 41.16: Pouch of Douglas incised and peritoneal cavity entered

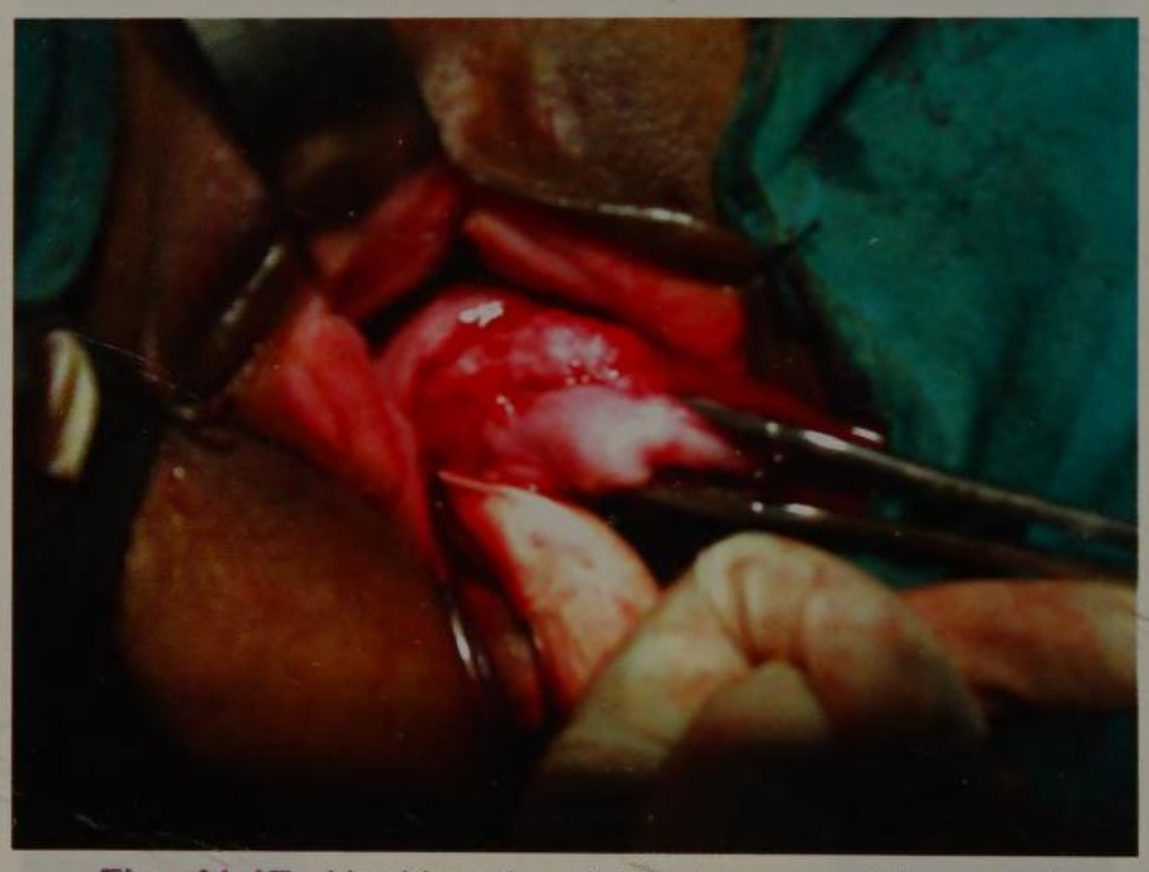

Fig. 41.17: Hooking the right uterosacral ligament

Fig. 41.18: Clamping the left uterosacral ligament

Fig. 41.19: Ligating the left uterosacral ligament

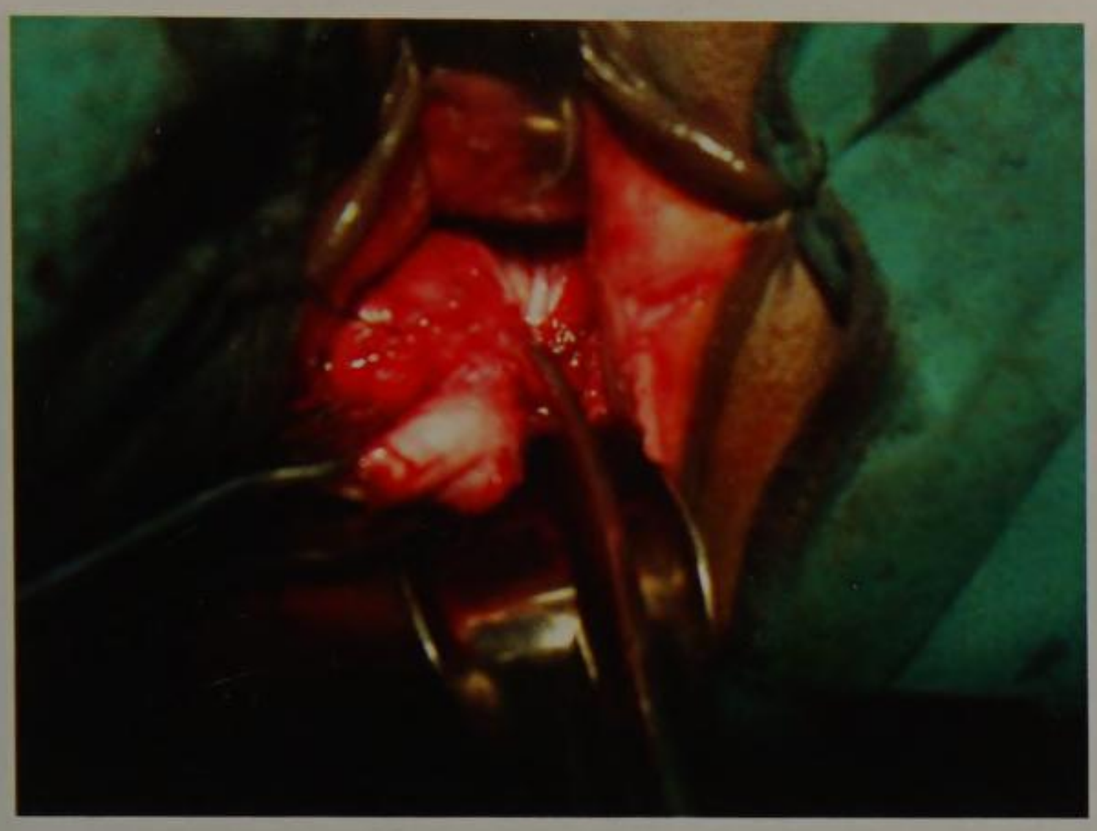

Fig. 41.20: Clamping the left uterine artery

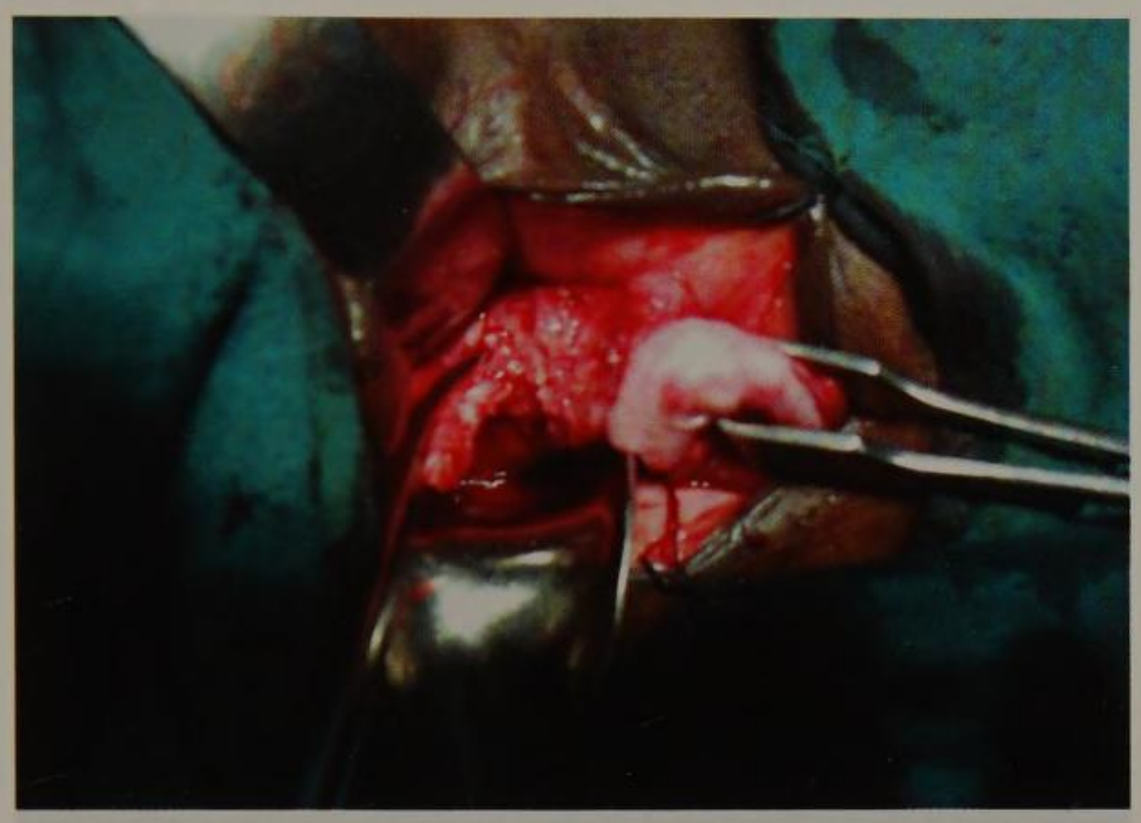

Fig. 41.21: Right uterine artery clamped and cut

Step 8

The final step entails clamping the broad ligament and fundal structures (tube, ovarian ligament and round ligament) in two clamps one above and below, cutting and transfixing with vicryl[1] (Figs 41.22 and 41.23). The upper and lower pedicles of either side are inspected and hemostasis secured if required (Fig. 41.24).

Step 9

The penultimate step would be to identify the anterior and posterior folds of peritoneum simply by holding the vaginal walls with Allis tissue forceps and finding the peritoneal folds behind the vaginal edges. Peritoneum is transversely sutured using monocryl 2-0 in a continuous fashion (Figs 41.25 and 41.26).

Step 10

The last step will be to approximate the anterior and posterior vaginal walls again in a continuous fashion using vicryl[1] (Figs 41.27 and 41.28). The pedicles may be tied together on each side; upper right pedicle to lower right pedicle and the same on the left side before vaginal closure. There is no need to transfix the pedicles to the vagina, which is not the practice anymore.[8] Finally the vagina is packed lightly using a ribbon gauze pack soaked in betadine. We prefer a plain saline pack so postoperative bleeding is easier to identify. An indwelling Foley's catheter is placed and both pack and catheter are removed the morning after surgery. The patient is ambulated on day 2 and discharged on day 3 of surgery.[7,8]

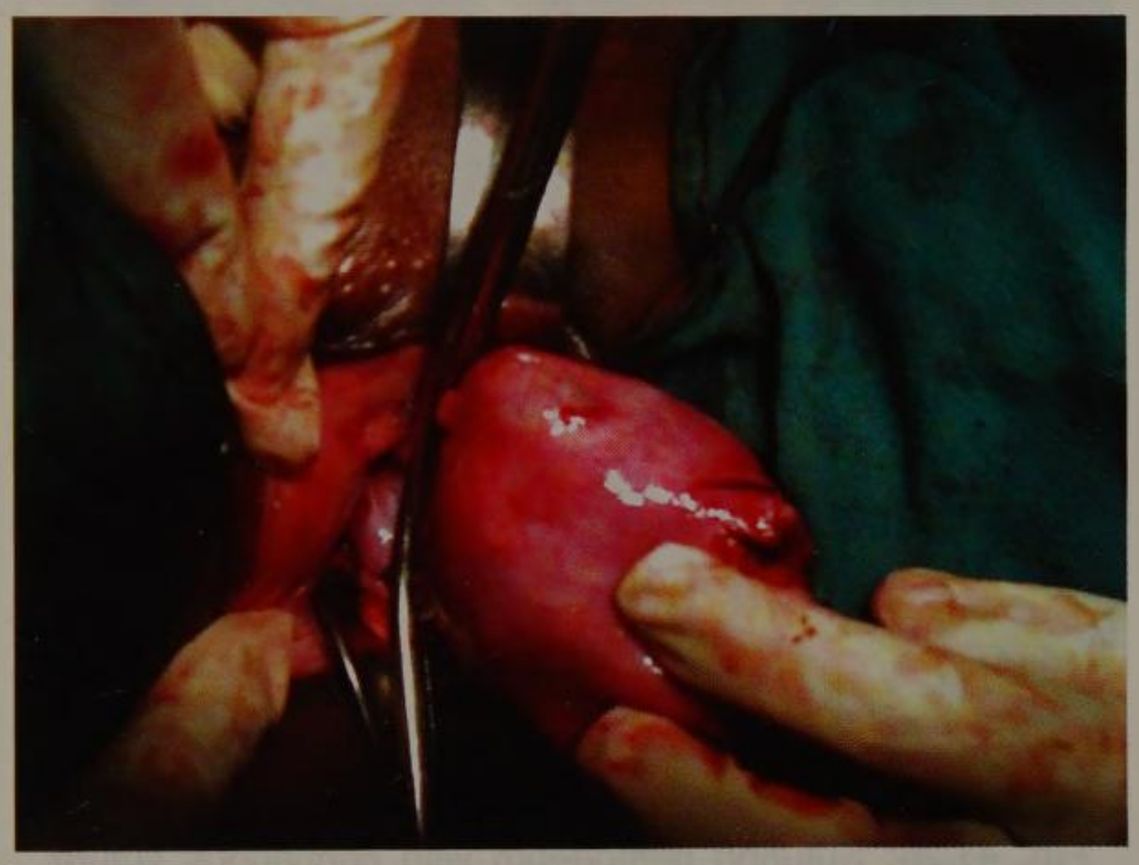

Fig. 41.22: Clamping the right fundal structures

Fig. 41.23: Right fundal structures transfixed and ligated

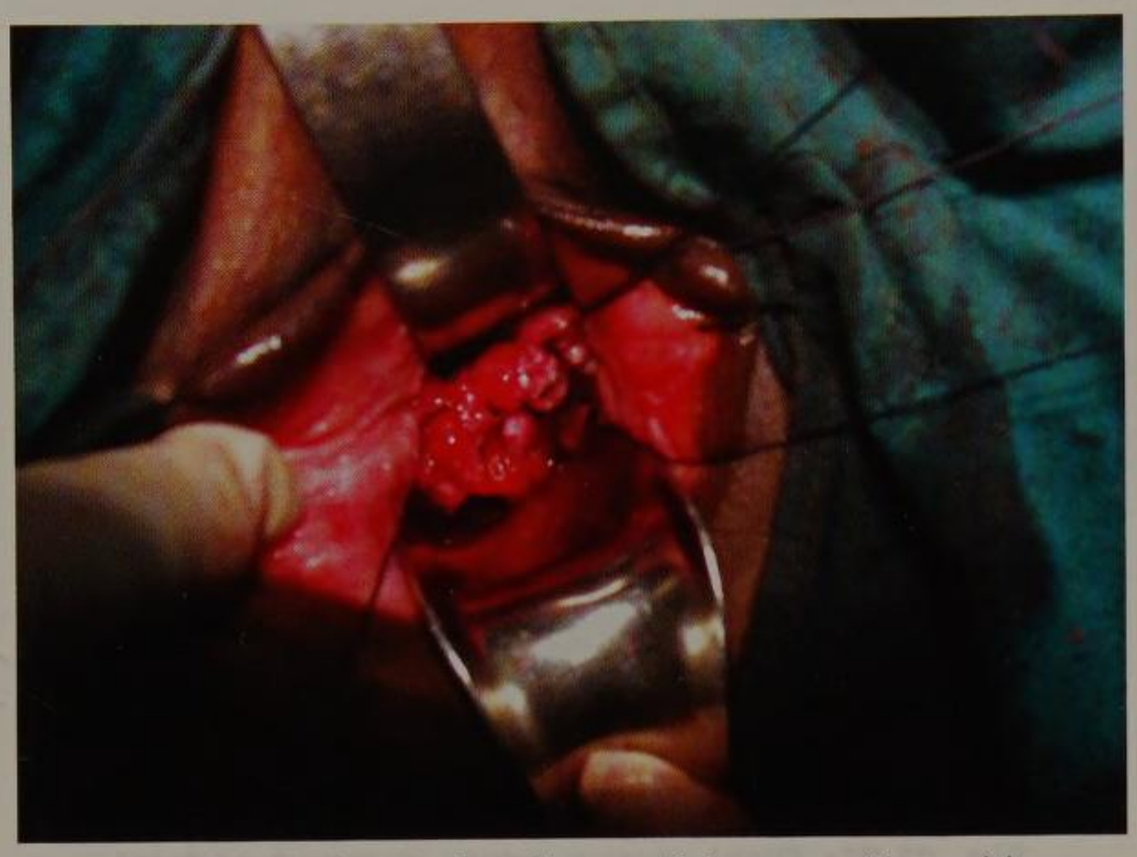

Fig. 41.24: Inspecting the pedicles on either side

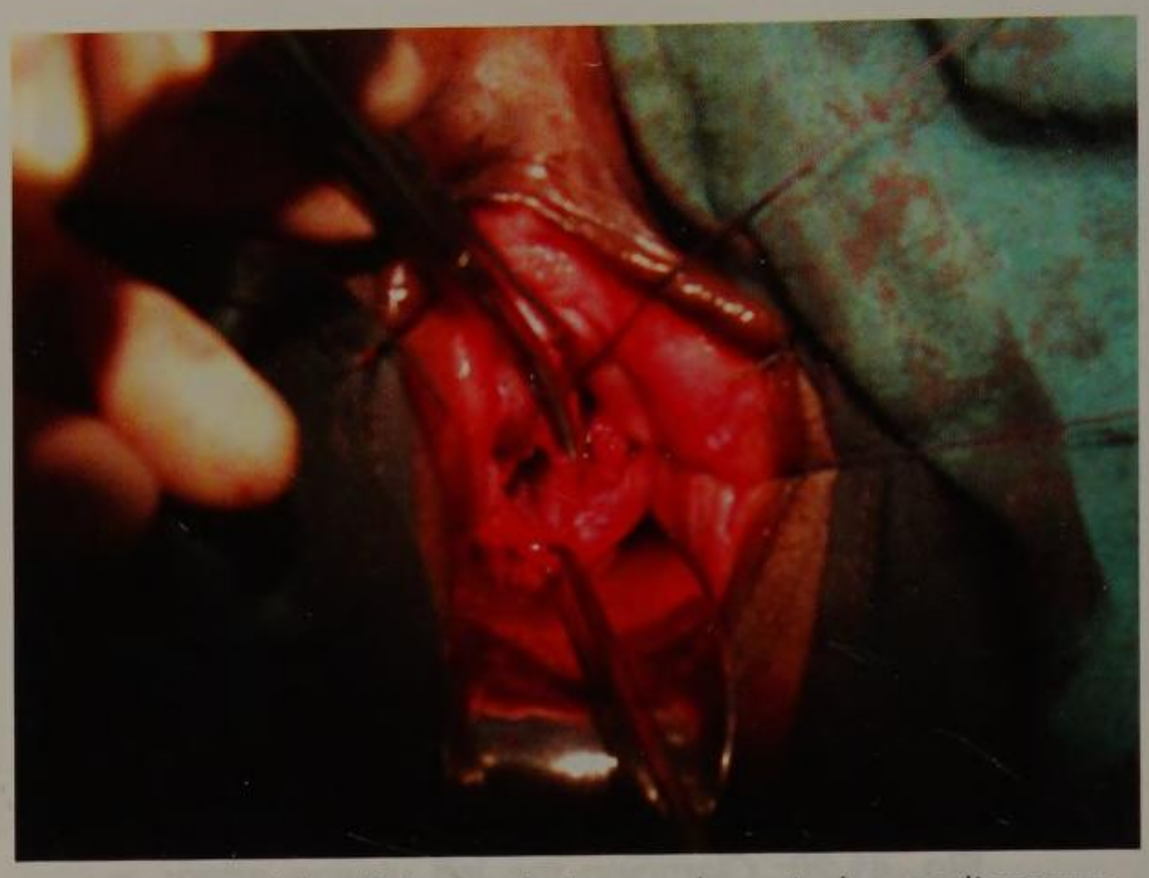

Fig. 41.25: Identifying anterior and posterior peritoneum

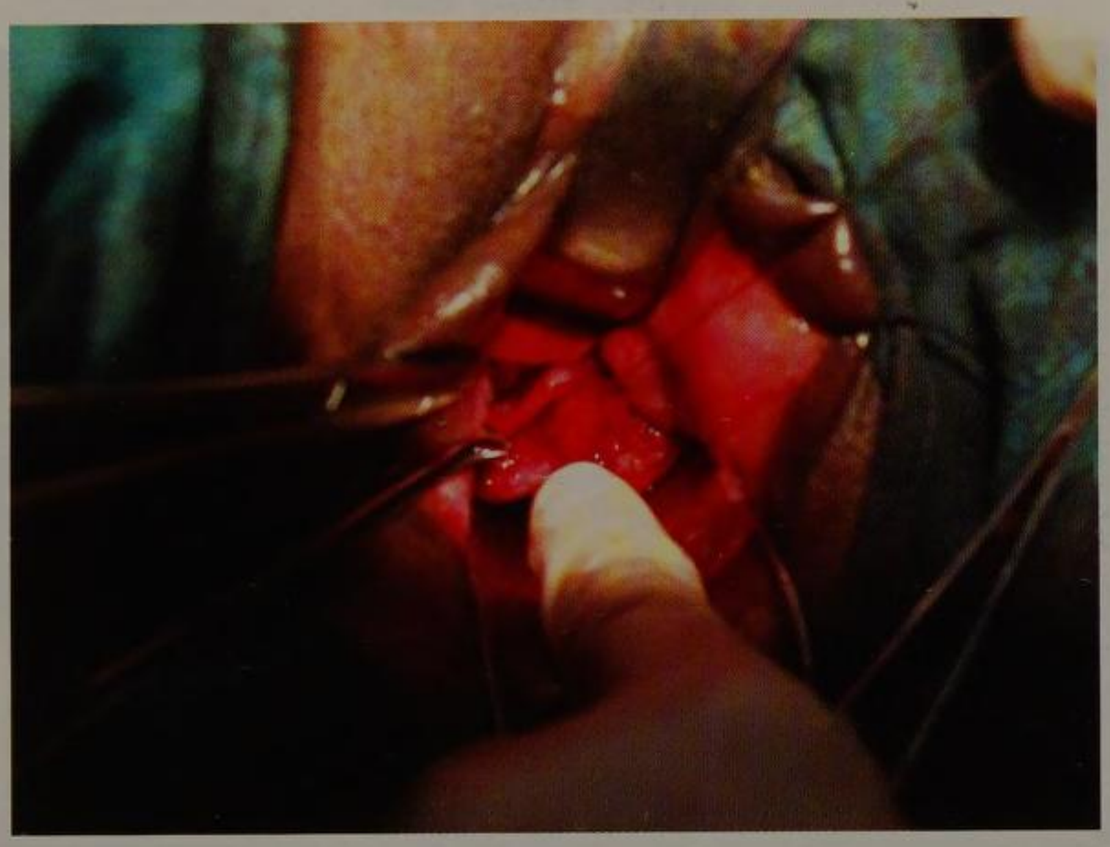

Fig. 41.26: Suturing peritoneum with continuous suture

Fig. 41.27: Vaginal edges identified for final closure

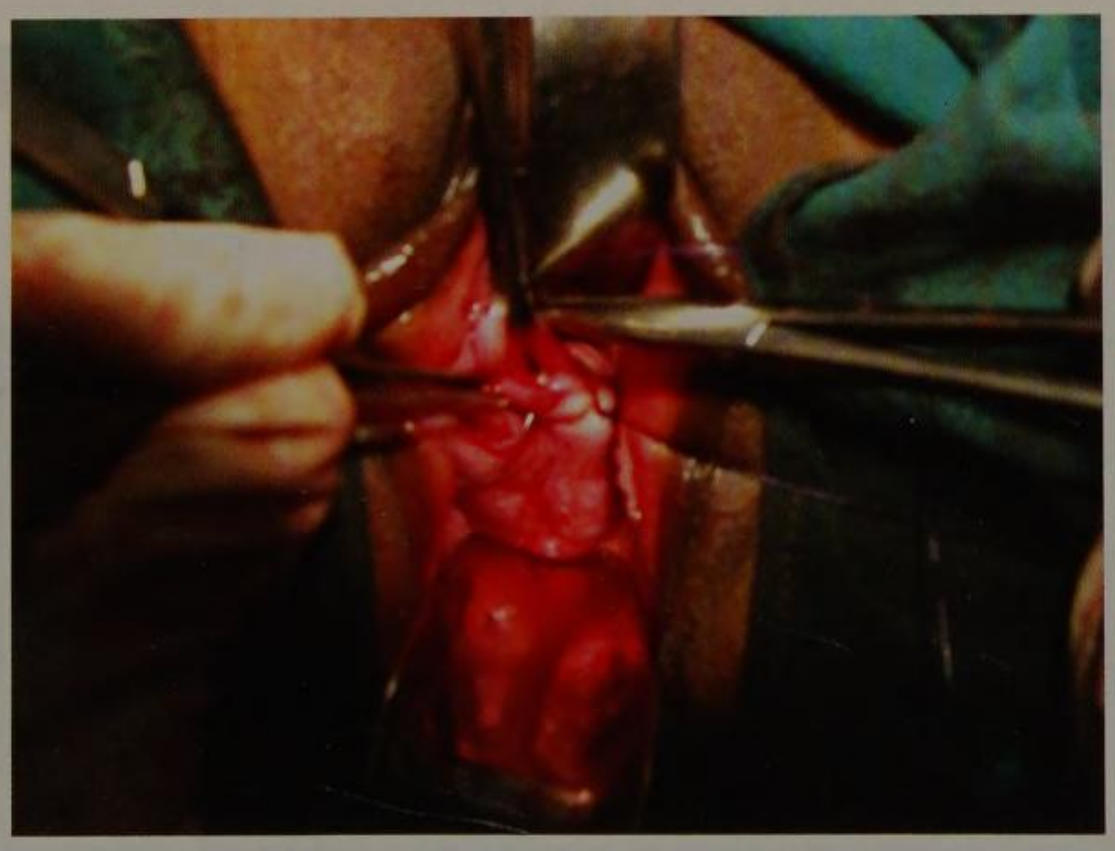

Fig. 41.28: Vagina being approximated with a continuous suture

Clampless Technique for NDVH

The clampless method for non-descent vaginal hysterectomy is a novel approach for the vaginal route of removal of the uterus. It is particularly useful because one is working in the narrow confines of the vagina and using clamps would mean occupying more space. It is particularly useful in women with large uteri and in nulliparae. However, we would recommend this method as the next level of experience, after having gained confidence in the basic method described in the previous chapter. Using clamps gives the surgeon a level of comfort because he is certain that the tissues are grasped firmly before cutting and ligating. However as the learning curve goes up the surgeon will find that working without clamps is a safe and superior method. Sheth uses this technique in all his vaginal hysterectomies[9] and our

technique is adopted from Dr. BN Purandare's video demonstration of the procedure.

Steps 1-6

Special instruments required for this technique is the self-retaining vaginal retractor. It is also preferable to use special pedicle needles or blunt needles on Vicryl No. 1 for this technique. Steps 1 to 6, i.e from catheterization, to holding the cervix, incising the anterior vaginal wall, opening the uterovesical fold of peritoneum, incising the posterior vaginal wall and pouch of Douglas to hooking of the uterosacral ligaments is the same as in the basic technique . The clampless method begins after this and it is preferable to open both pouches before proceeding further. Dr. Purandare uses two silk stay sutures held by artery forceps on either side of the cervix for traction but we prefer to use the cat's paw as it gives a firmer grip and good traction.

Step 7

This step consists of identifying and hooking uterosacral ligaments on either side and passing a ligature in the manner shown in Figure 41.29 and tying firmly. Traction on the tied uterosacral ligament is applied to facilitate cutting as shown in Figure 41.30.

Step 8

After ligating and cutting the uterosacral ligaments on either side the uterine vessels are ligated firmly using a double stitch before cutting. The precaution taken here is to cut close to the uterus (Figs 41.31 and 41.32).

Step 9

The next step would consist of securing the lower part of the broad ligament again using a ligature and cutting close to the uterus (Figs 41.33 and 41.34). Once this is done the rest of the broad ligament is dealt with in the method shown in step 10.

Step 10

This step consists of three ties; the first tie secures the tube and round ligament anteriorly (Fig. 41.35). The second ligature is taken to secure the ovarian ligament and remaining broad ligament and a third free tie secures the entire pedicle together (Fig. 41.36). A straight artery forceps placed behind the fundal structures as shown in Figure 41.37 may be used to take the free tie.

Step 11 and 12

The pedicles are inspected for any bleeding and the peritoneum identified as described in Step 9 of basic technique and sutured antero-posteriorly using a continuous suture. Likewise the vagina is closed transversely using a continuous suture.

In conclusion the clampless technique is a unique procedure particularly suited to vaginal surgery where there is limited space and one must consider switching over to this technique after having mastered the basic technique using clamps.

Fig. 41.29: Ligature passed through right uterosacral ligament

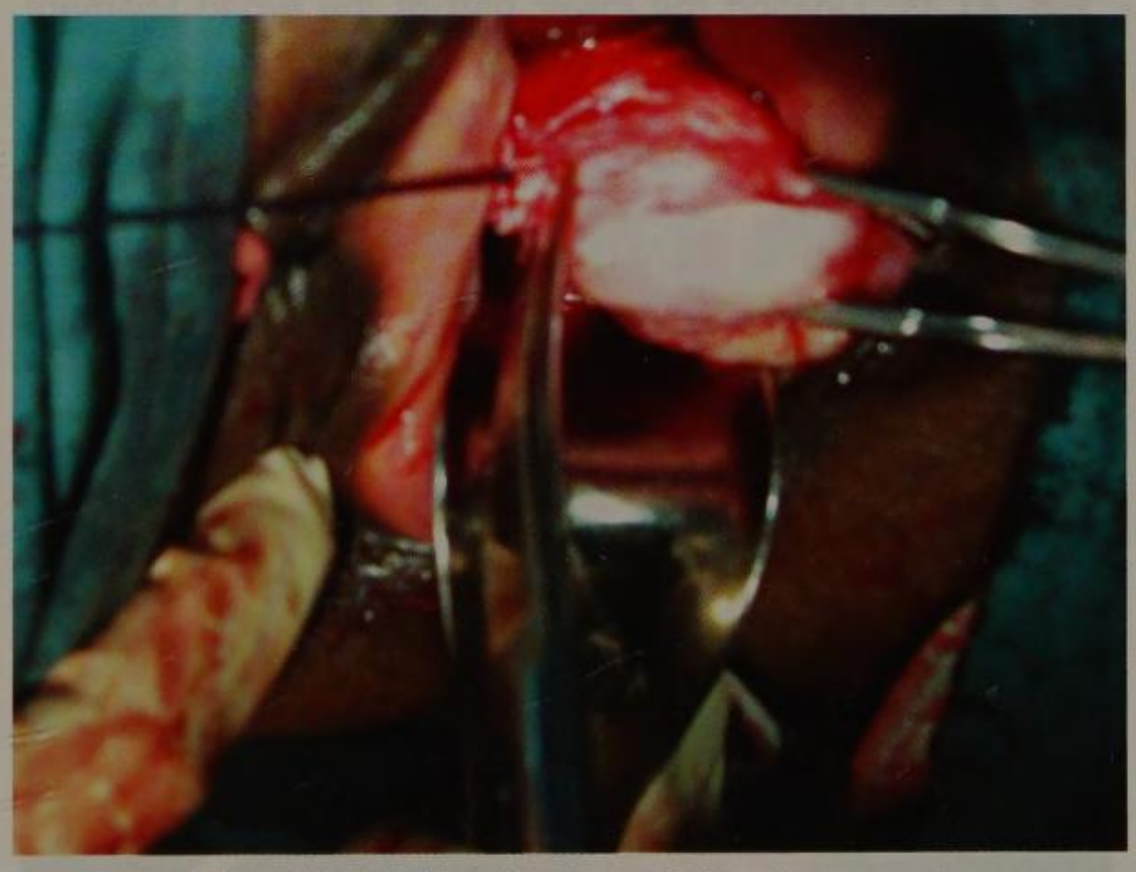

Fig. 41.30: Traction on right uterosacral ligament before cutting

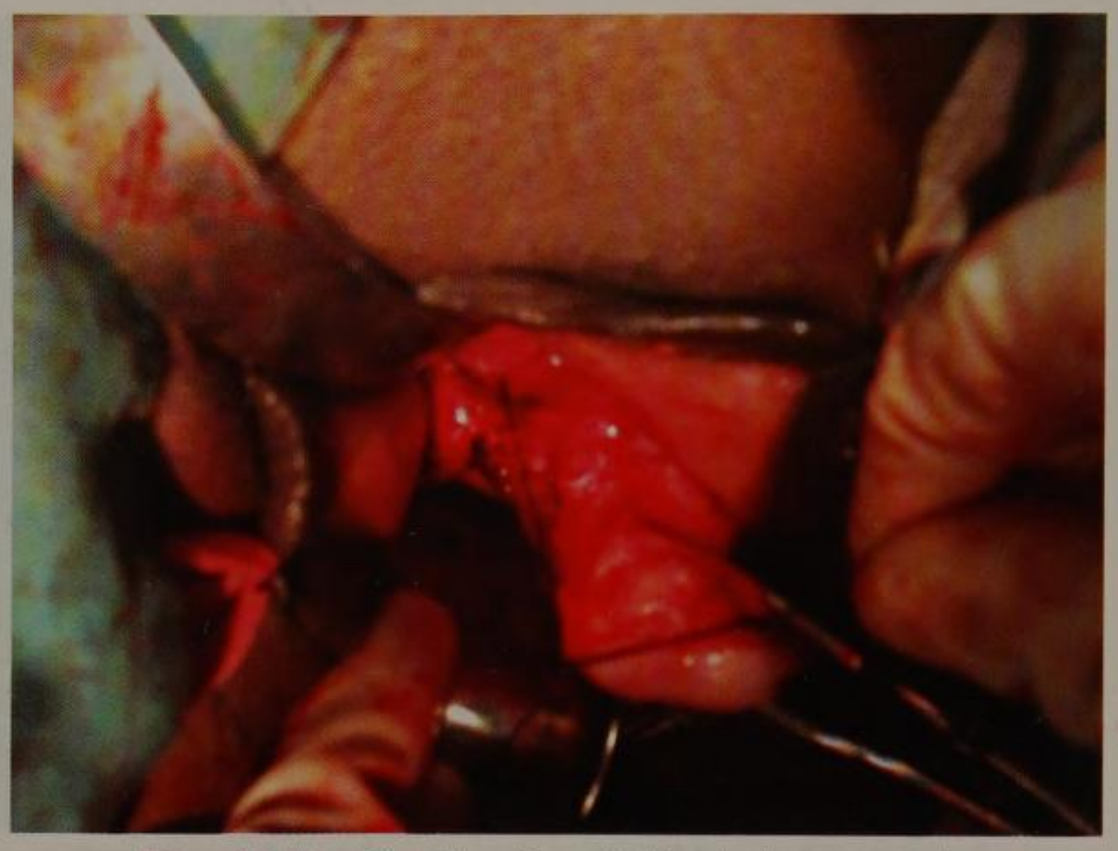

Fig. 41.31: Ligating the right uterine vessels

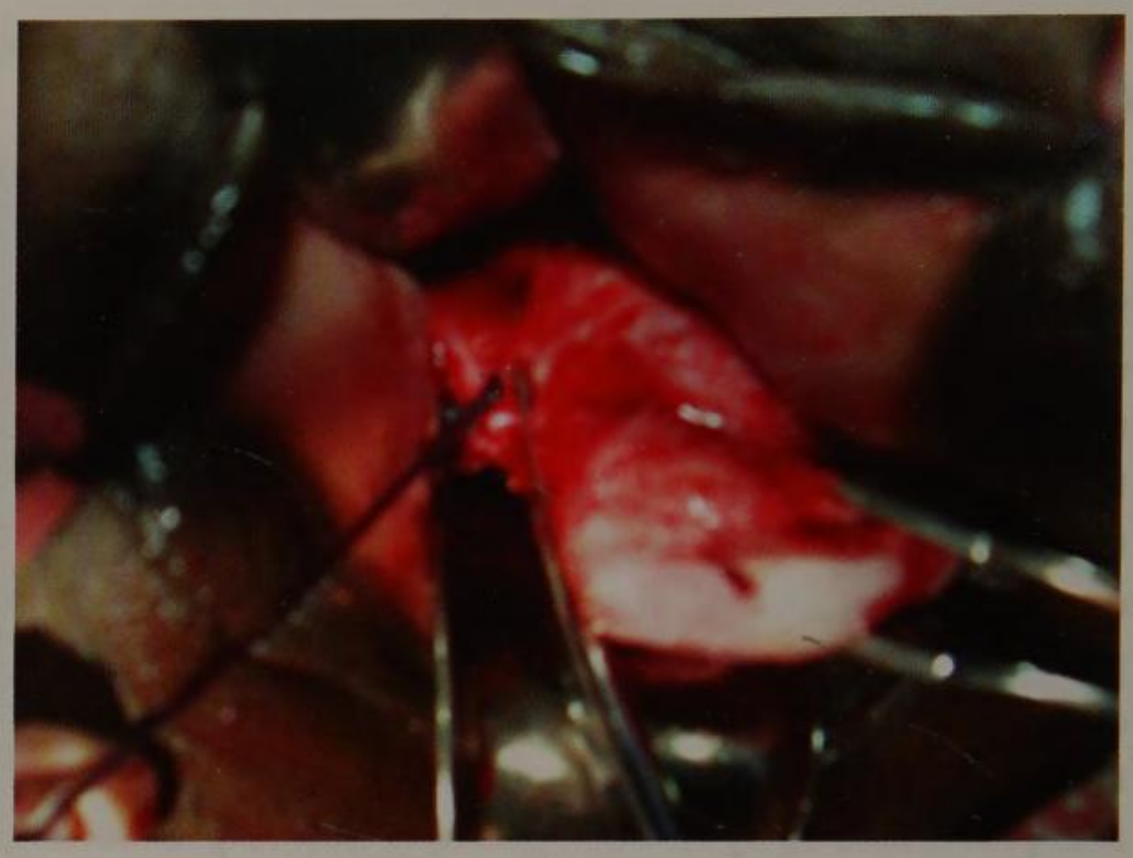

Fig. 41.32: The right uterine vessels being cut after doubly tying

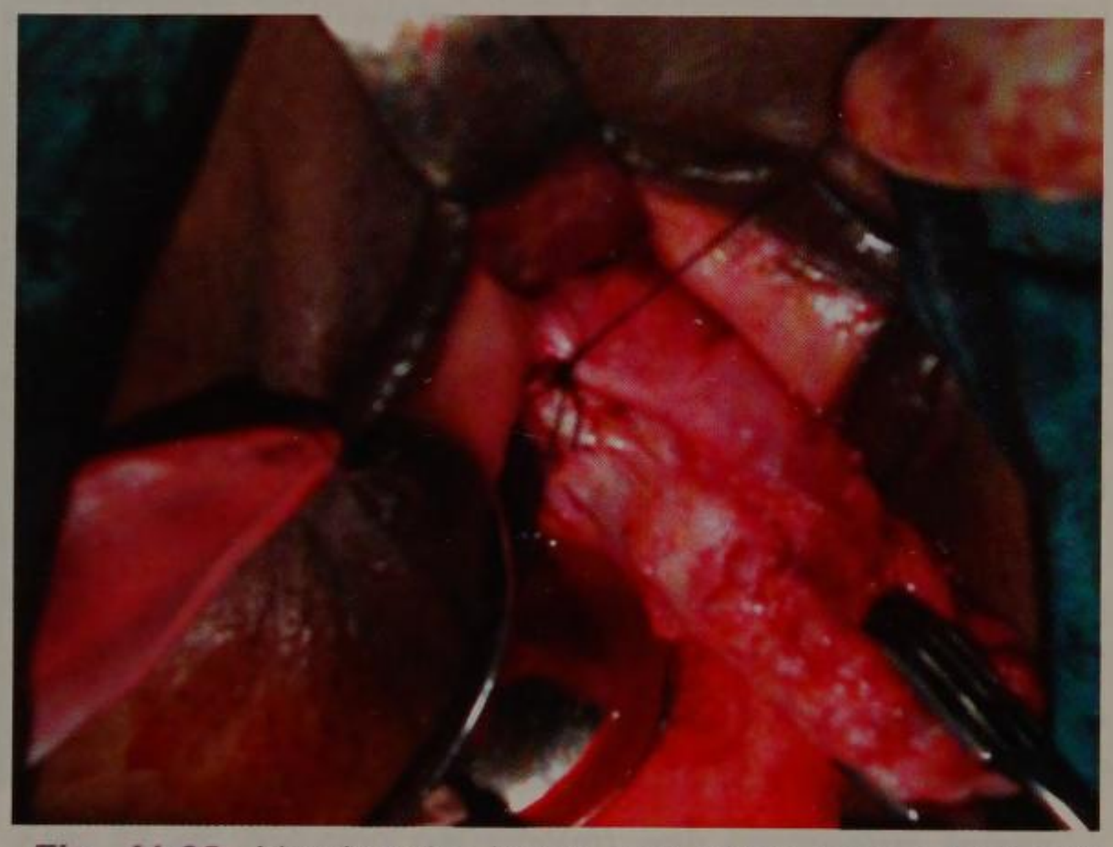

Fig. 41.33: Ligating the lower part of the broad ligament

Fig. 41.34: Appling traction on and cutting the lower part of right broad ligament

Fig. 41.35: Finger hooked behind ovarian and round ligament and first ligature taken

Fig. 41.36: Right ovarian and round ligament being tied

Fig. 41.37: Right fundal structures cut

CONCLUSIONS

Hysterectomy can be performed more easily, faster, with least complications and with excellent patient recovery when the vaginal route is used for hysterectomy. Revival of this route can be attributed to the widespread use of the laparoscopic approach because major portion of LAVH is accomplished vaginally. The technique requires only standard instruments and sutures and gaining expertise in NDVH would mean serving 80% of the world i.e., developing countries better. Marketing the procedure as 'scarless surgery' would also make it more popular.

Key Points

1. After proper selection, a peroperative assessment is done for descent, mobility, size of uterus, uterine free space laterally and adequate pelvic space.
2. A good operative set-up, proper lighting and position are essential prerequisites.
3. Self-retaining vaginal retractors and the cat's paw are invaluable instruments for non-descent vaginal hysterectomy.
4. Both the basic and clampless technique are described in detail with color illustrations and in the accompanying video.
5. After becoming confident with the basic technique one can ascend the learning curve to the clampless technique.
6. Less operative time, lower intraoperative complications, less blood loss and early postoperative recovery are advantages of this technique.

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42 Volume Reductive Vaginal Hysterectomy

Neerja Goel, Shalini Rajaram, Rachna Agarwal

INTRODUCTION

Recent interest in minimally invasive hysterectomy for enlarged uteri has rekindled a need for effective transvaginal techniques of uterine specimen removal. This has two components: detachments of all the attachments of uterus including vaginal walls and *reduction of uterine volume*.

Volume Reductive Surgeries

Currently employed strategies of volume reductive surgeries include *uterine bivalving/bisection, myomectomy, wedge morcellation and intramyometrial coring*.[1-4] These techniques are safe and facilitate the vaginal removal of moderately enlarged and well-supported uteri without increasing perioperative morbidity.[5] They reduce the operative time, hemorrhage and lower the postoperative complications. A successful operation is related to uterine size, morbility, operative skill and surgeon's experience.[6] Various volume reduction techniques have been described and defined by Magos[7] in 1996 as follows:

Bisection[7]

The cervix is grasped on both sides and the uterus is bisected sagittally towards the fundus, using a knife. The bisection is carried out first along the posterior uterine wall, aided by the repeated repositioning of the vulsella close to the apex of the incision, combined with rotation of the cervical portion of the uterus around the pubic arch. If necessary, the uterus is rotated back to its original position and the bisection pursued anterior. Complete bisection often allows half the uterus to be delivered through the vagina and the ovarian pedicle to be secured; the same procedure is performed on other half of the uterus.

Myomectomy/Enucleation[7]

Myomectomy is frequently combined with bisection or morcellation. Smaller myomas are removed in one piece while larger ones are morcellated and removed in fragments.

Morcellation[7]

Morcellation is carried out on the uterus when despite bisection or myomectomy no further descent is possible. Bisection is recommended as soon as further descent of the uterus is achieved after myomectomy and morcellation. Morcellation can be done in form of wedge resection (Pryor technique, 1899)[8] or slicing method (Goel et al, 2005).[9]

Intramyometrial Coring[7]

Coring is performed instead of bisection when dealing with smaller uteri without any distinct large myomas. A circumferential incision is made at the level of uterine isthmus about 5 mm into the substance of the corpus. A central core of tissue around the uterine cavity is then excised by progressively undercutting the serosal surface of the uterus towards the fundus. Once the uterus is delivered into the vagina the hysterectomy is completed. All of the above procedures are done in particular after ligation of uterine vessels to decrease the perfusion of uterus and prevent excessive blood loss.

Preoperative Evaluation of Large Uteri before Vaginal Hysterectomy by Ultrasound

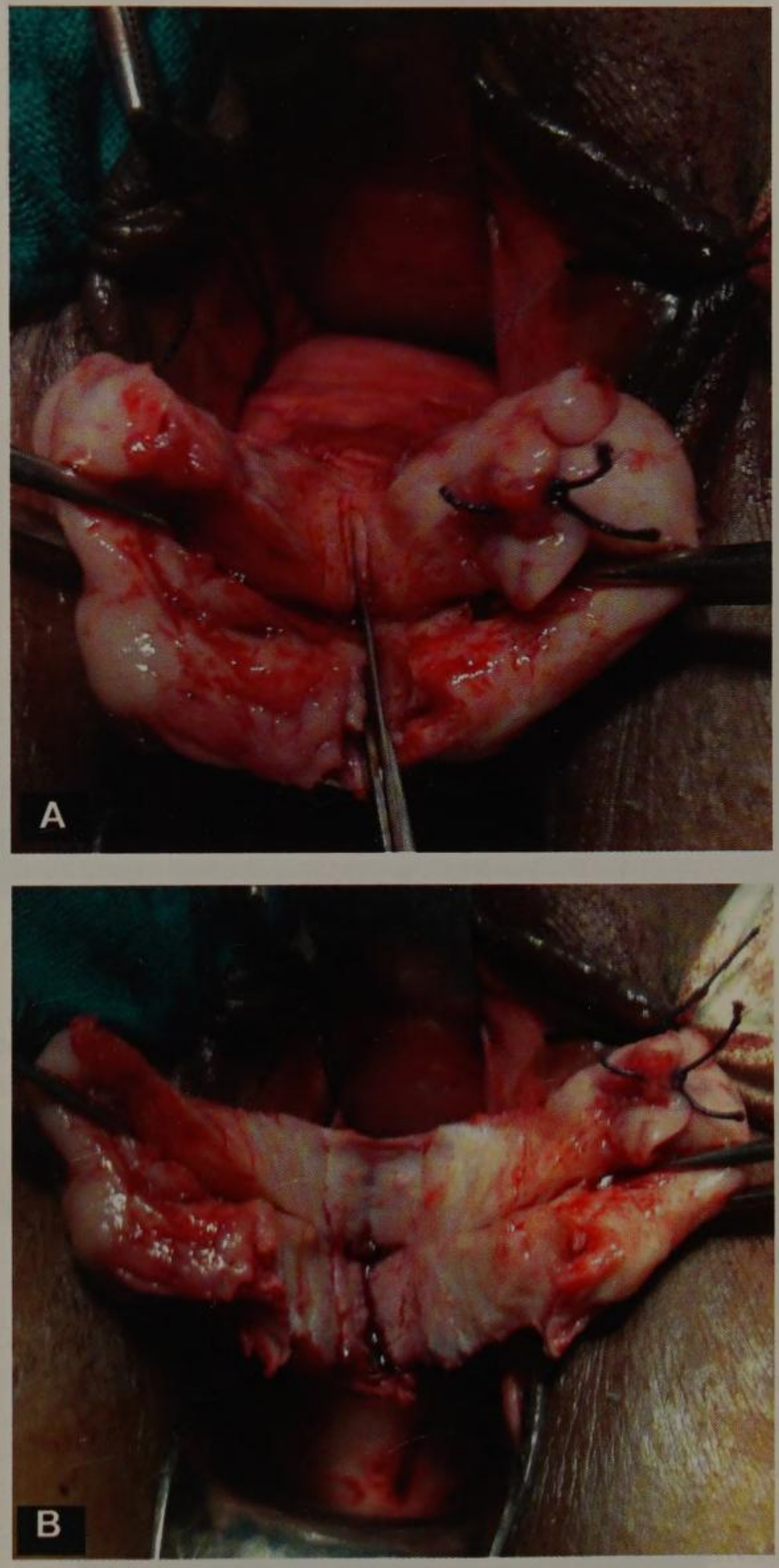
Preoperative ultrasound should be done for uterine biometry, endometrial thickness and to note the presence of fibroid, adenomyosis or myohyperplasia. The size, location and number of myomas should be noted and the procedure of volume reduction planned accordingly.

GnRH analogues may be administered few weeks preoperatively to reduce the size of the fibroids and vascularity of the uteri (Magos 1996).[7] Any adnexal pathology should be ruled out.

Steps of Volume Reduction Procedure in NDVH in Representative Cases

Bisection and myomectomy in a case of single fibroid enlarging the uterus up to 14 weeks size.

1. Preoperative evaluation, labial sutures, empty the bladder.
2. Hold the anterior lip of cervix by vulsellum, sound the bladder, incise vaginal mucosa, push the bladder up, open the anterior pouch, and introduce bladder retractor.
3. Hold the posterior lip of cervix, incise vagina, and open the posterior pouch.
4. Hold both the lips with cat's paw and clamp, cut and ligate uterosacral, Mackenrodt's ligaments and uterine vessels.
5. Hold the lips of cervix at 3 and 9 position. Start bisecting the anterior and posterior lips, the endocervix and reach till the uterocervical junction (the bigger the uterocervical angle the better is the ease of surgery, it should be > 100 degrees)[9] (Figs 42.1A and B).
6. Put the index finger and feel the fibroid in the cavity. Try getting a cleavage plane between fibroid and uterine wall as much as possible.
7. Apply myoma screw on the most dependent part of fibroid till it is fixed and ensure that the anterior or posterior wall of uterus is not taken in the instrument. Keep giving traction and separating the fibroid from all the uterine walls circumferentially by finger dissection. If the fibroid is firm or calcified the myoma screw will not give way, but in degenerated fibroids while pulling it tends to get detached. Keep reapplying the myoma screw. The fibroid may come out with the inverted uterus. Quickly separate the fibroid and reposit the inverted fundus. Patient may have fall in BP.
8. If the fundal clamps can be put on both sides complete the hysterectomy otherwise bisect it completely (Fig. 42.2). Reposit one half inside the pelvis (Fig. 42.3) to get free space for fundal clamps of other side and then the other half also is removed. Myomectomy can be done prior to removal of one half of the uterus at the surgeon's discretion if the fibroid is present at the fundus region (Figs 42.4 and 42.5).
9. Haemostasis is secured. Tie the fundal and uterosacral pedicle with each other. Peritonise in clockwise direction. Close the vaginal vault transversely making sure the angle are everted.
10. Pack the vagina with betadine soaked ribbon gauze. Put Foley's catheter and check for urine.



Figs 42.1A and B: Holding the cervix laterally and bisecting the uterus towards the fundus

Fig. 42.2: Complete bisection of uterus

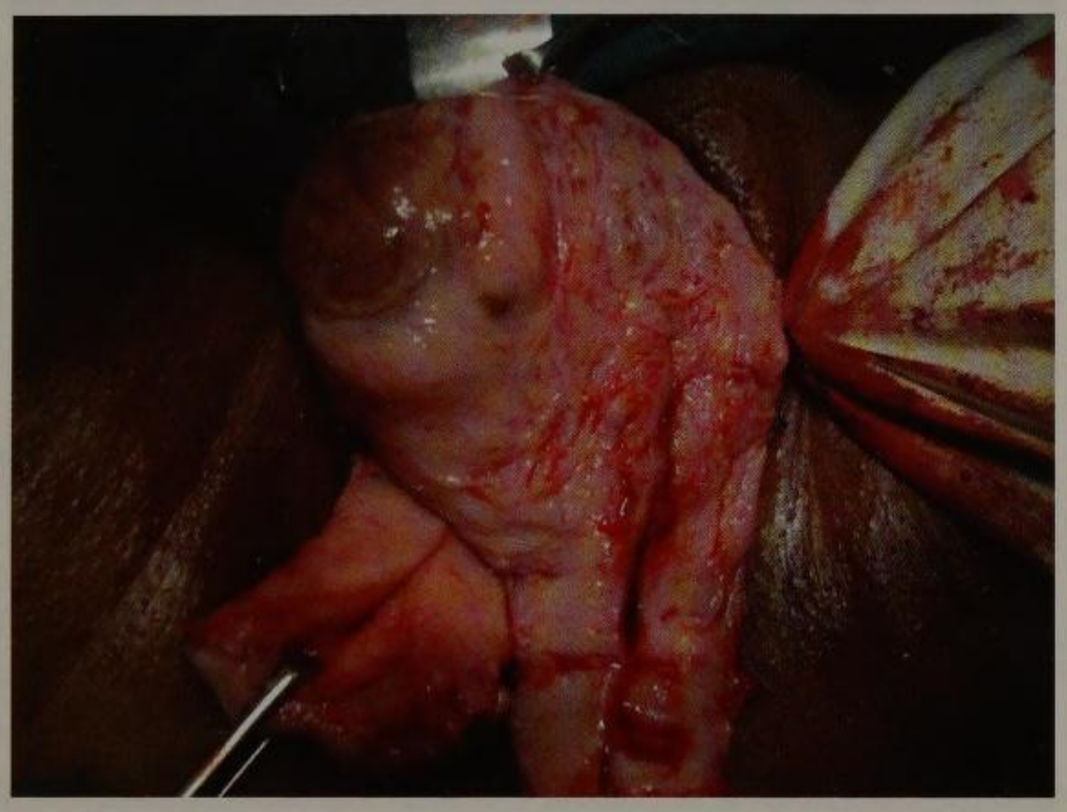


Fig. 42.3: One half of uterus reposited inside

Fig. 42.4: Fibroid seen at the fundus

Fig. 42.5: Myomectomy done for fibroid at the fundus

A Case of Multiple Intramural Fibroids

Steps 1-4 are common for most of the cases as described above.

5. For anterior wall fibroids do not be in a hurry to open the anterior pouch, as it may be high (Fig. 42.6A).
6. Uterosacral, Mackenrodt's ligaments are severed. Clamp the uterine vessels extraperitoneally.
7. Bring the uterus down as low as possible then incise the anterior wall till the myoma bulges. Put the myoma screw and complete enucleation. If the fibroid size is too big circumferential *intramyometrial coring or morcellation* can be done.[7]
8. To clamp the fundal structure put a curved clamp around, feed a double suture and tie the pedicle and cut. Laparoscopy may be needed in some cases.
9. Posterior wall fibroids are easier to be removed by enucleation or morcellation after bisection.
10. It is always better to remove the small fibroids by lateral tunneling, i.e. removal from the inside of uterus unless it is bulging obviously on the external surface. By doing so the external surface of uterus is not disfigured and amputation of uterus into small fragments is avoided. The uterus should be removed intact as far as possible.

In cases of fibroids posing difficulty (enumerated below), a combination of various volume reductive procedures may enable NDVH.

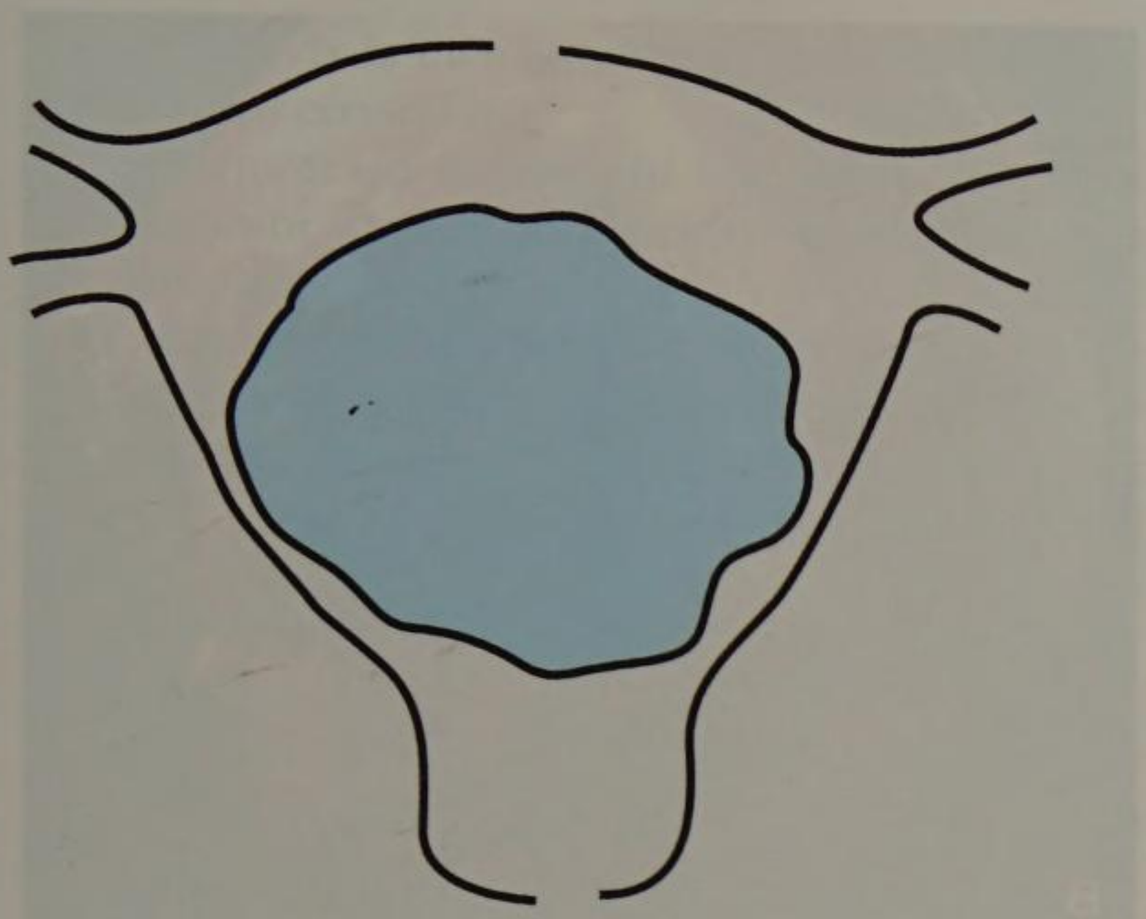


Fig. 42.6A: Anterior wall fibroid

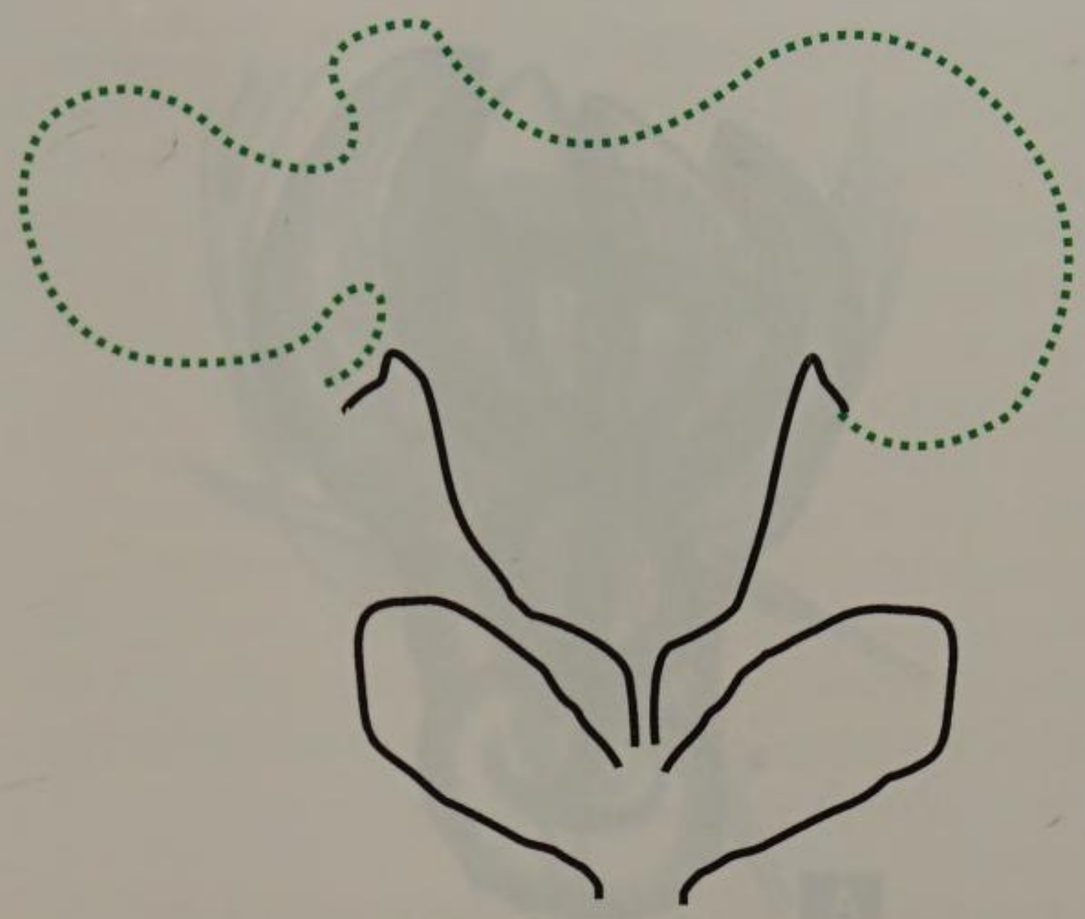


Fig. 42.6B: Large fibroids (>10 cm) in fundal region prevent descent

1. The fibroids at the uterocervical junction decreasing the angle to <90 degree.
2. At fundal region, increasing the diameter to more than 10 cm not allowing the descent of the uterus (Fig. 42.6B).
3. Lateral extension to broad ligament.
4. Degenerated fibroids in a bigger uterus.
5. Fibroids causing gross asymmetry of the uterus.
6. Cervical fibroid.

Steps of Morcellation in Case Adenomyosis by Slicing Method[9]

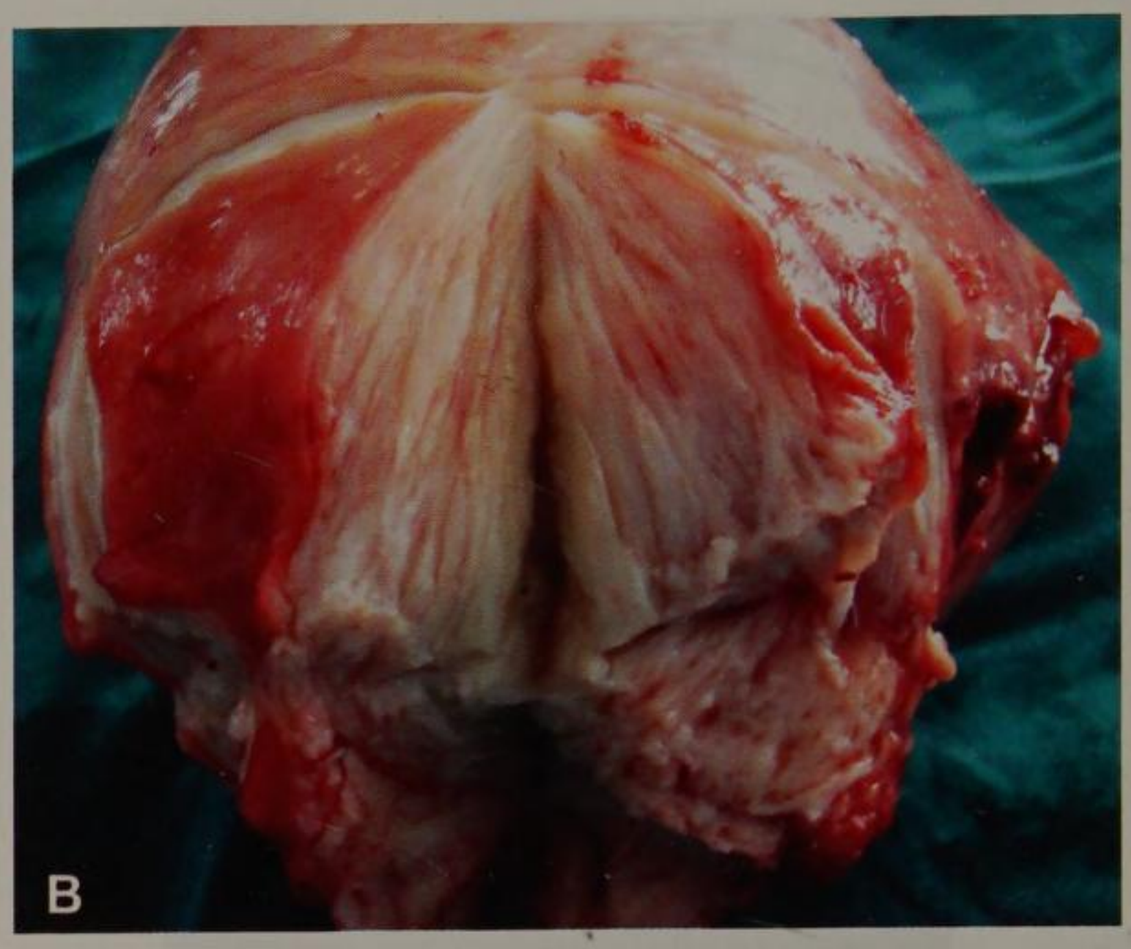
Adenomyosis usually presents with uterine size not more 12-14 weeks gestation. There are no planes of cleavage and enucleation is not possible. Goel et al improvised the volume reductive technique in NDVH to deal with problems of adenomyosis.[9] After bisecting the uterus, the inner surface is exposed and the myometrial tissue is sliced off the uterus layer by layer. Care is taken not to pierce the serosa so as to avoid the inadvertent injury to intra-peritoneal structures. Once the bulk is removed hysterectomy can be completed (Fig. 42.7).

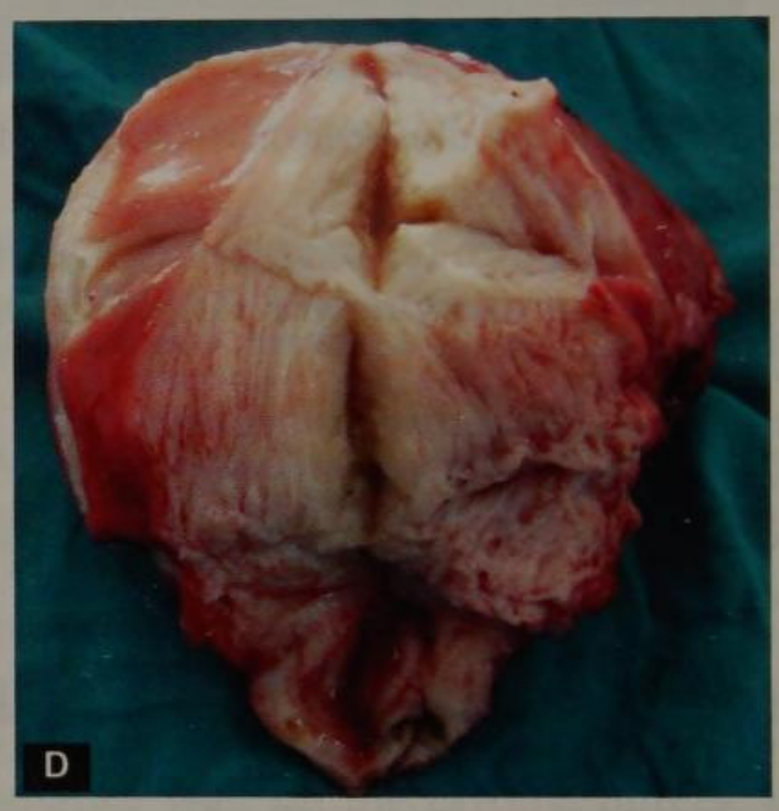
Fig. 42.7: Slicing of myometrium for volume reduction (N Goel's technique)

Pryor Technique of Uterine Morcellation[2] (Figs 42.8A to D)

This technique merits attention for its systematic and reproducible approach to transvaginal wedge morcellation of the enlarged uteri. Used by Pelosi III in 1997 to reduce uterine bulk and found it to be a safe and efficient method to enable NDVH.[2]

1. In this first both anterior and posterior peritoneal pouches are opened and bladder and intestine retracted.
2. The anterior wall of the uterus is split as high as possible. Holding the everted edges of the uterus, a strip of tissue about a quarter of an inch wide is cut first (Figs 42.8A and B) from one side and then from the other (Fig. 42.8C). A half-inch has now been taken out of the entire visible anterior uterine wall. The removal of this amount of tissue from the cervix will usually be all that can be taken away without reaching its sides.





Figs 42.8A to D: Pryor morcellation strategy removes symmetrical wedges of the anterior uterine wall to facilitate exposure and access to adnexal pedicles (A) artist's sketch (B, C, D) Wedge morcellation technique shown on a hysterectomy specimen in a sequential manner from cervical to fundal region respectively

3. The other slices cut out will be above the cervix and limited to the body of the uterus (Fig 42.8D). In most cases it will be found that the removal of the first two strips has so weakened the anterior uterine wall that the median splitting of the anterior wall can be continued, and the common uteri can be brought into view beneath the bladder.
4. In some cases the bladder is attached so high upon the uterus that the dissecting finger cannot effect this separation. Then it will be necessary to split the uterus up as high as possible and remove from each side one, and perhaps two wedge-shaped pieces with their bases upward.
5. The stumps are firmly grasped and the anterior wall pulled further down, while the bladder is pushed up so as to expose more of the uterine tissue. What appears is again split in the middle line, and from each side a wedge of tissue is removed. Progressively pulling down the uterus and cutting out the pieces, the cornua will appear. So far there has been free capillary bleeding but none from vessels of large size.
6. When the cornua come into view, if necessary, a large wedge is cut from the fundus, the base of which is at the top of the uterus.
7. The uterine arteries are clamped by two forceps and the cervix is freed with scissors.

8. The cervix is then amputated at the level of the internal cervical os.
9. A firm grasp is taken of the stumps, and the posterior uterine wall is morcellated as was the anterior.
10. After proceeding half way up the uterus in this manner it may often be found that the uterus is so shelled out that it may be partially inverted, or that one cornu may be brought so far into view that forceps may be applied to the ovarian artery close to the cornua.
11. Uterus is cut loose upon one side and delivered out of the vagina. The enucleation of the adnexae attached to this large portion of the uterus is then made as though the uterus had been split in half, and it is removed with the adnexa of that side as in hemisection.

All through such an operation as described utmost care must be exercised not to wound the side structure either by scissors or traction forceps.

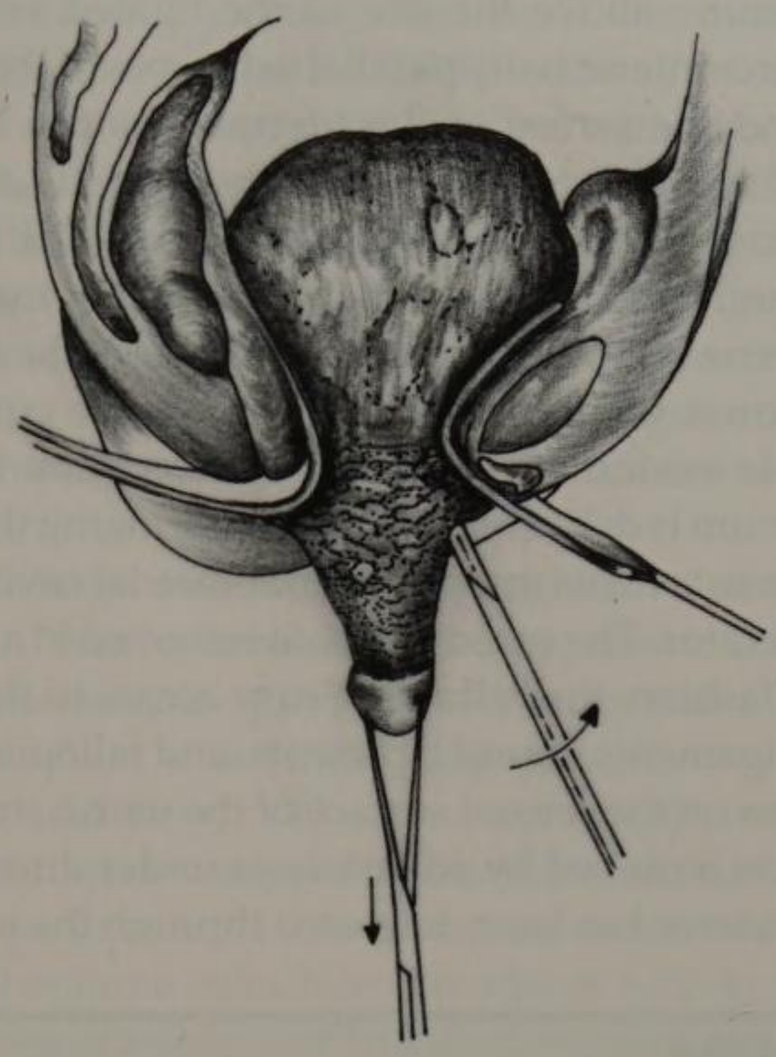


Fig. 42.10: After ligation of the uterine arteries, an incision is made in a circumferential fashion parallel to the endometrial cavity and into the outer superficial myometrium in the same place. Constant traction on the tenaculum while coring assists in developing the proper plane

Steps of Intramyometrial Coring[3] (Figs 42.9 to 42.11)

Once the uterosacral and cardinal ligaments and uterine vessels have been ligated and the pedicles secured, the

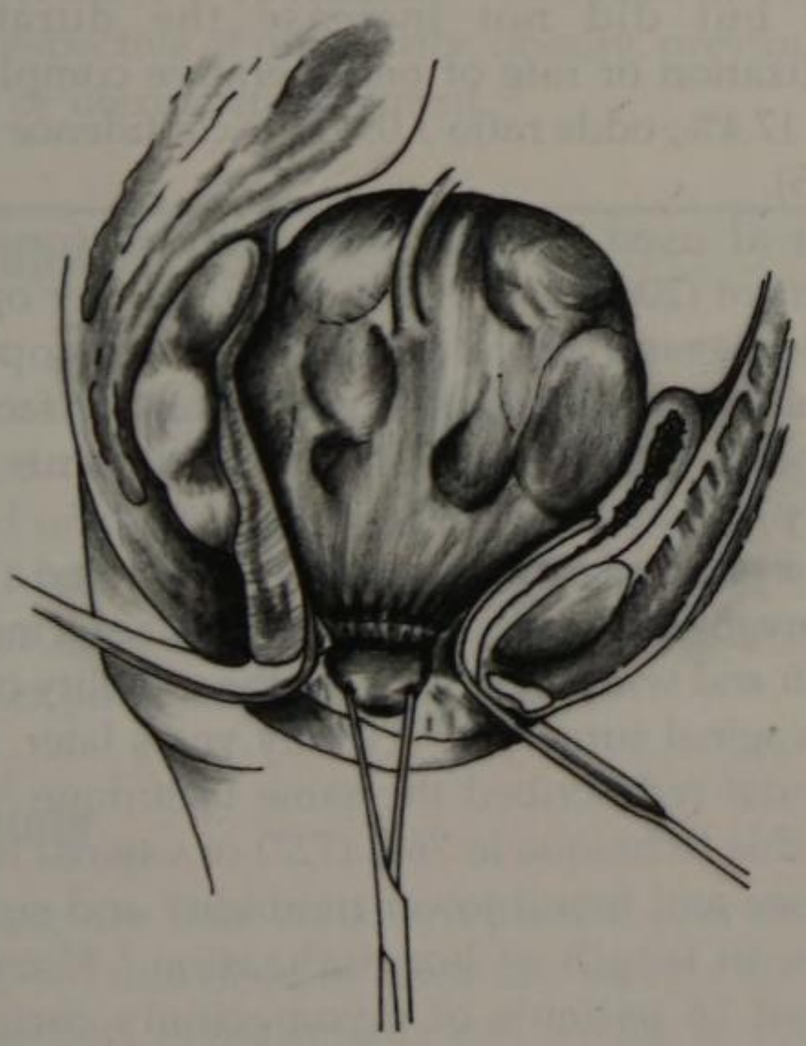


Fig. 42.9: Coring: The cervix has been circumscribed through full thickness of the vagina around the cervix, the posterior and the anterior peritoneum opened and uterosacral and cardinal ligaments secured

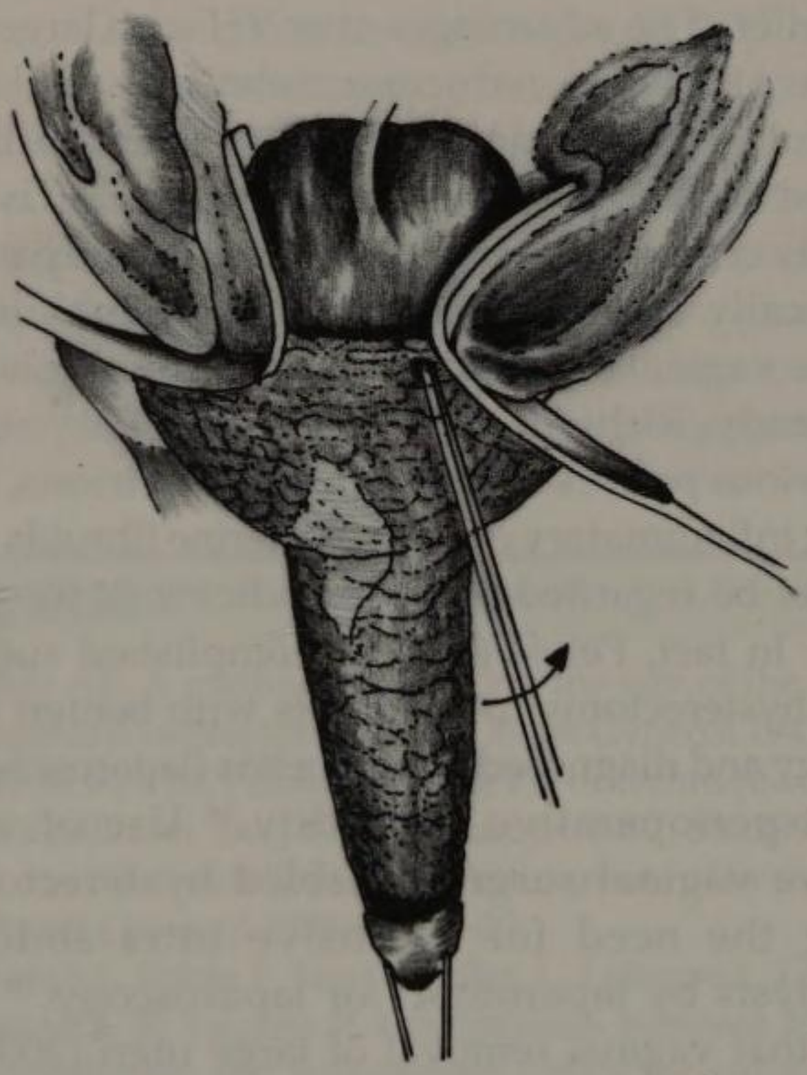


Fig. 42.11: Continued coring and traction reduces the size of the uterus by exteriorizing the inside of the uterus with an intact endometrial cavity through the introitus

myometrium, above the site of the ligated vessels, is incised circumferentially parallel to the axis of the uterine cavity and the serosa of the uterus. Caution must be exercised not to extend the knife through the serosa of the uterus. The incision is carried around the full circumference of the myometrium in a symmetrical fashion beneath the serosa of the uterus. As the cervix is pulled down, the avascular myometrium is cut so that the whole endometrial cavity with a thick layer of myometrium is delivered with cervix, bringing the inside of the uterus with its unopened endometrial cavity closer to the operator. The cored uterus is removed in a straight forward fashion, thus allowing easy access to the utero-ovarian ligaments, round ligaments, and fallopian tubes. Adhesions on the serosal surface of the uterus, tube, and ovaries are removed by adhesiolysis under direct vision once the uterus has been delivered through the introitus.

DISCUSSION

Indications of volume reductive NDVH: Darai, et al compared 40 cases of vaginal hysterectomy (VH) (larger than 280 gm) with 40 cases of laparoscopic assisted vaginal hysterectomy (LAVH) and found less complications in VH group (37.5 vs 15%) and shorter operative time (156 vs 108 min).[10] They concluded that LAVH offered no advantages over VH with large uterus with use of volume reduction techniques and can be successfully completed vaginally.[10] Similar results were observed by Kovac[11,12] and Richardson.[13] The main suitability criteria for NDVH in benign uterine pathology in medically stable patient are uterine mobility and adequate vaginal exposure and not the uterine size.[14] In a later study, Richardson[13] and Unger, et al[15] reported that previous pelvic surgery, mild endometriosis, history of pelvic inflammatory disease or uterine fibroids should no longer be regarded as contraindications for vaginal surgery. In fact, Pelosi (1997) accomplished successful vaginal hysterectomy in 8 patients with benign uterine pathology and diagnosed frozen pelvis (laparoscopically) without perioperative morbidity.[16] Use of volume reductive vaginal surgery enabled hysterectomy by passing the need for extensive intra-abdominal adhesiolysis by laparotomy or laparoscopy.[16] Unger proved that vaginal removal of large uteri (200-700 g) with respect to uteri of volume <200 g is not linked with increase in complications and length of hospital stay.[15] Magos et al successfully removed even larger uteri (380-1,100 g) with the adjunct of uterine volume reduction techniques.[9] He concluded that uterine size by itself should no longer be considered a contraindication to vaginal hysterectomy.[9] Contraindications to VH should include women with very narrow vagina and no uterine descent or suspected ovarian masses.[9]

The use of leuprolide acetate as medical volume reduction has been suggested when size is a limitation in vaginal surgery but it increases cost to the patient.[17] Laparoscopy may be an alternative for very large uteri, in assisting to mobilize utero-ovarian pedicles, gaining entry into the peritoneal cavity and mobilizing any pelvic adhesion and lastly a valuable tool for adnexectomy. But again instrument cost and increased operative time are limiting factors for the use of laparoscope.[18]

Morcellation: Mazdisnean et al retrospectively studied "volume reductive" technique by morcellation for uterine weight >300 gm and found it to be cost-effective technique compared to use of abdominal/laparoscopic approach.[19] Krammerer-Doak et al performed 59 vaginal hysterectomies with morcellation and compared with 281 cases without morcellation and found no statistically differences in surgical or anesthetic risk factors including parity, obesity, hormonal status and pre-existing medical disease.[5] Mean uterine weight (222 vs 110 g, p<0.001) was significantly greater than those undergoing without morcellation. Morcellation significantly increased the duration of the procedure (mean 140 vs 168 minutes, p0.004) but did not increase the duration of hospitalization or rate of perioperative complications (18.6 vs 17.4%, odds ratio 1.09, 95% confidence interval 0.49-2.35).

Li et al used uterine morcellation for uterine enlargement (200-700 gm) and found shorter operative time, decreased blood loss, lower postoperative complications and length of hospital stay.[6] In fact, Pelosi has reported a case of 2,003 gm fibroid uterus remove vaginally by morcellation.[2]

Intramyometrial coring: Lash (1941) described a method of intramyometrial coring to reduce the size by increasing its length and width and increase the mobility of uterus during vaginal surgery.[1,20] Twenty years later, Nichols and Randal redescribed the same technique.[21] Kovac studied this technique in 76% (727) of vaginal hysterectomy cases and found lower morbidity and significant decrease in length of hospitalization.[3] Nazah et al compared 16 patients of myomectomy coring with bisection, morcellation and found both to be safe and effective for reducing large uteri.[2] Coring appeared effective for a wide uterus wherein cleavage plain can easily be found and followed. When the uterine width is

reduced, dissection within the myometrium might be difficult to achieve. Postoperative fever was significantly more common after myometrial coring.[2]

All four volume reduction techniques and their comparison: Liu et al used all four techniques for reducing uterine bulk on 25 cases of uteri (155-755 gm) and found that most useful method was bisection combined with myomectomy and morcellation.[23] The operative time varied from 60 to 150 min. The average blood loss and postoperative hospital stay was 50 ml and 5.3 days receptively.[22]

Figueiredo et al used all four techniques of volume reduction in 170 out of 270 cases of VH and concluded that critical uterine size that predicates these procedures were 10-12 weeks gestational equivalent to the breadth of the pubic arch.[23] However, if the uterus was relatively immobile, morcellation is needed at smaller uterine size.[16] The advantage of reducing bulk in both settings is improved access to the broad ligament attachments and proximal adnexal pedicles.[9,14]

Benassi et al (2002) performed 60 vaginal hysterectomy cases with the use of all volume reduction techniques.[23] The most simple and commonly used procedure was bisection. He concluded that very large uterine volume (30-1160 gm) didnot represent a real obstacle for a gynecologic surgeon who had expertise in vaginal volume reductive operations.[23] In fact, NDVH can be done irrespective of nulliparity, obesity, previous pelvic surgery or uterine enlargement.[23]

CONCLUSIONS

Volume reductive vaginal hysterectomy is an indispensable technique for large uterus and should be practiced more frequently by all gynaecologist and included under residency training programme.
Vaginal hysterectomy for large uteri aided with reduction technique has clear surgical advantages for its economy and better patient satisfaction.

Key Points

1. There are four volume reductive procedures for NDVH described in literature: uterine bivalving/ bisection, myomectomy and wedge morcellation, intramyometrial coring.
2. Technique of morcellation varies in various studies, classically being the Pryor technique.
3. Bisection is a simple and most commonly used technique to enable NDVH followed by myomectomy in cases of enlarged uteri with fibroid.
4. When uterine width is reduced, bisection-morcellation is preferred over intra myometrial coring.
5. Various studies have concluded that large uteri (upto 700 g) removed vaginally with these reducing techniques have low complication rates comparable with those for VH for uteri under 200 gm.
6. For large uterine fibroid "vaginal volume reduction" is more cost-effective compared to abdominal laparoscopic approach or preoperative medical reduction with GnRH analogues.
7. In addition, VH associated with reducing techniques compare favourably with AH in terms of perioperative complications and blood loss.
8. All volume reductive procedures help to decrease operative time and length of hospital stay.
9. Preoperative selection of cases is of utmost importance for successful vaginal surgery. Uterine size or absolute fibroid size is not important. More important is location of fibroid as lower segment fibroid obstructing the descent of uterus and pelvis may hinder vaginal approach.
10. Uterine and adnexal immobility or inaccessibility are relative contraindications to NDVH but may become less troublesome as experience in volume reductive procedures increases.
11. Volume reductive techniques have learning curve which is rapid compared with that for advanced laparoscopic techniques and it retains the efficiency of classic surgery with simple durable inexpensive and readily available equipment.

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43 Technique of NDVH in Nulliparous, Obese and Women with Previous Surgeries

Shirish S Seth, Kurush Paghdiwalla

INTRODUCTION

Numerous studies have shown that vaginal hysterectomy is less morbid, less expensive, and results in a more rapid recovery than either abdominal or laparoscopically assisted hysterectomy[1,2] and can be performed successfully in 50% to 80% cases.[3] Interestingly, women with a large uterus, prior pelvic surgery, or without uterine prolapse are generally thought to be poor candidates for vaginal hysterectomy. Currently, in the United States, abdominal hysterectomy exceeds vaginal hysterectomy by at least a 3:1 ratio for the treatment of benign disease, whereas the vaginal route is mainly restricted to the treatment of prolapse.[4]

The most common factors limiting the use of vaginal hysterectomy have been a lack of uterine prolapse, nulliparity, history of pelvic surgery, excessive uterine size, obesity and the need for prophylactic oophorectomy. These criteria have greatly limited the use of the vaginal route and have supported a high frequency of abdominal and laparoscopically assisted hysterectomies in women without a uterine prolapse. In actuality, none of them is categorically a contraindication to vaginal hysterectomy. More often, they become excuses to defend taking recourse to LAVH or total abdominal hysterectomy instead of the vaginal method.[5] The large variations in practice indicate that the route of surgery is more dependent on the surgeon's preference than on the medical condition.

Although absolute and relative contraindications to the vaginal approach for hysterectomy[5,6] are well defined, some deviations do appear from time to time because of surgeon's personal inclination.

The absolute contraindications are:[3]

Common

1. Uterus more than 12 weeks' size or uterine volume more than 300 cm^3.
2. Restriction of uterine mobility.
3. Adnexal pathology.

Uncommon

1. Cervix flush with the vagina, or Fothergill's operation makes cervix look most unlike a cervix.
2. Inaccessible cervix:uncommonly, after repeated uterine surgery, particularly, cesarean section, there are dense adhesions between the uterocervical surface, the bladder and the lower abdominal wall which makes the cervix inaccessible to an approach by the vaginal route (Figs 43.1 and 43.2). These adhesions can be anticipated by simple speculum examination and by the presence of Sheth's cervico-fundal sign.[7,3]

   Sheth's cervico-fundal sign:
   a. Stretched posterior vaginal wall pulled upwards in its upper half and inability to visualize cervix or barely visualized even after the use of an anterior vaginal wall retractor and/or Vulsellum.
   b. Cervix placed high almost behind or close to the pubic symphysis.
   c. Traction on the cervix, with some difficulty, pulls the lower abdominal wall inwards, almost dimpling it.

   With a rise in the cesarean section rate, gynecologists should be aware of such adhesions.
3. Vesicovaginal and/or rectovaginal fistula repair.
4. Invasive cancer of the cervix.

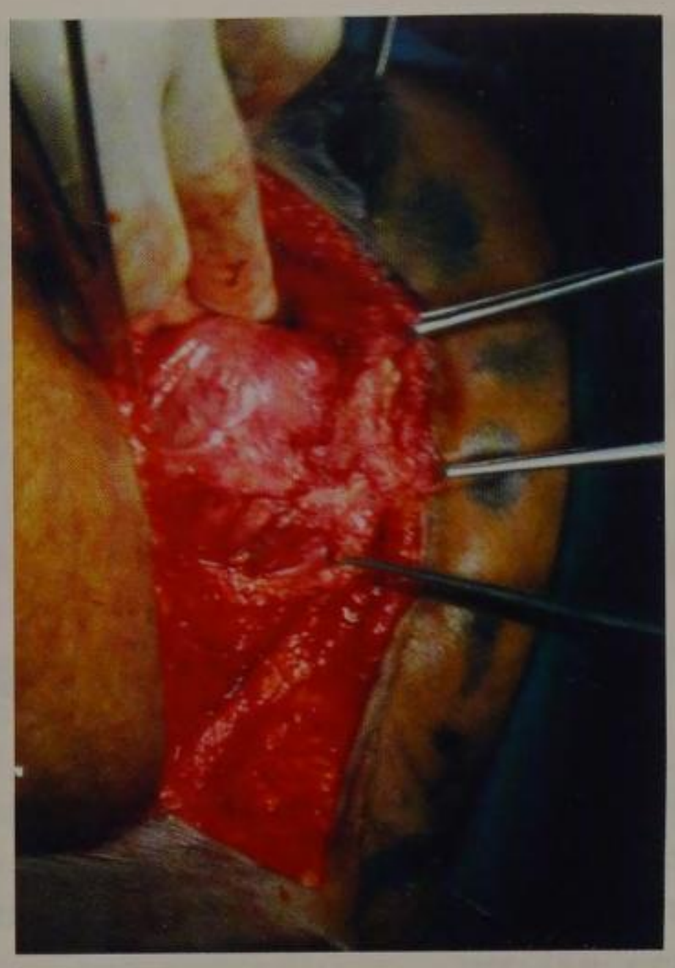


Fig. 43.1: Classic adhesions seen at laparotomy in woman with history of Caesarean Section(s). Deaver's retractor and fingers are at the umbilical level, close to the upper end of the right paramedian incision. The uterine fundus of a normal size uterus is seen well between the symphysis pubis and the umbilicus with body and bladder densely adherent to the lower abdominal wall

Fig. 43.2: Speculum examination demonstrates Sheth's cervico fundal sign in a woman with history of Caesarean Sections. Stretched and pulled up posterior vaginal wall and unseen cervix (high up behind pubic symphysis)

A contracted bony pelvis; angle of the pubic arch less than 90 degrees, need to explore the upper abdomen and lack of surgical expertise is often mentioned to dissuade vaginal hysterectomy. Laparoscopic evaluation can easily replace the need for opening of abdomen to explore the abdominal cavity.

Many of these contraindications often become relative, depending on the patient, the condition, the surgical expertise of the surgeon, and concomitant conditions being treated.

Vaginal hysterectomy could be the route of choice not only for women with genital tract prolapse, but also for those without.[8,9] In fact, no literature evidence exists to contraindicate vaginal hysterectomy in absence of prolapse or states that prolapse is a prerequisite for vaginal hysterectomy.

The vaginal route is associated with significant benefits in terms of reduced hospital stay, improved patient recovery, and early return to work.[10,2,11] In following text, nondescent should be taken as uterus without prolapse.

Vaginal Hysterectomy for Nulliparous Women

For many gynaecologists nulliparity is an absolute contraindication to the vaginal route irrespective of the size of the uterus. This is based on the presumption that nulliparity is associated with nondescent. Although nulliparous patients have narrower or less patulous vaginal dimensions and lesser descent than multiparous patients; in the absence of pelvic pathology, when examined under anaesthesia,every nulliparous woman will show physiological descent. This is sufficient to permit start of a vaginal hysterectomy and each further step facilitates the next one (Table 43.1).

In a large series of 300 patients by Agostine et al[12] only three patients had to be converted to the abdominal route, thus achieving a 96.2% success rate. If doubt persists even after EUA, a trial VH with or without preceding laparoscopic evaluation should easily resolve any apprehension and permit successful completion. In fact, in many; vaginal hysterectomy is technically easier in nulliparous women because of the smaller cervical and uterine size.[13] Vaginal hysterectomy was possible without difficulty in 120 young mentally handicapped nulliparous women; most of them were with an intact hymen.[14] However, multivariate analysis showed that only uterine weight, i.e. preoperative uterine volume assessed from careful sonography, was an independent predictor of intraoperative complications and laparo-conversion. Thus, it seems that patients with nulliparity were more likely to undergo a vaginal hysterectomy if they had did not have an unduly enlarged uterus.

Table 43.1: Practical steps to assist or promote vaginal hysterectomy (VH)

Nullipara	*Previous Surgery*	*Obesity*
1. *EUA 2. Preoperative sonography for uterine volume 3. Smaller instruments 4. Schuchardt's Incision, occasionally 5. Labial Sutures 6. Uterus free space availability 7. Bisection/Morcellation 8. Preoperative counseling 9. Trial vaginal hysterectomy 10. Laparoscopic Evaluation, if required.	*Previous caesarean/myomectomy:* 1. *EUA 2. Preoperative sonography for uterine volume 3. Access to vesicouterine peritoneum through uterocervical broad ligament space or lateral surgical window 4. Trial vaginal hysterectomy 5. Rarely, laparoscopic evaluation. *Other pelvic/abdominal surgery* 1. *EUA 2. Extracare in accessing pouches 3. Mild adhesiolysis near tubal area. 4. Trial vaginal hysterectomy 5. Occasionally, laparoscopic evaluation.	1. *EUA. 2. Preoperative sonography for uterine volume 3. Labial sutures. 4. Special long retractors, clamps and scissors and Jayle's lateral vaginal wall retractor 5. Fibreoptic light facility. 6. Extra care and double ligation of pedicles. 7. Trial vaginal hysterectomy

* EUA (Examination under anesthesia): For decision making, EUA should always be with the patient in extended lithotomy.

In a large study of over 300 cases by Octacllio Figueiredo, et al,[15] nulliparity, previous pelvic surgery, uterine enlargement, or obesity did not impede successful vaginal hysterectomy when it was applied uniformly to a group of women without uterine prolapse. Despite a 50% prevalence of previous cesareans in their subjects, the incidence of surgical bladder injury (0.67%) was easily comparable to the range of 0.3-1.0% commonly quoted for total abdominal hysterectomy[16] comparable to the range of 0.5-1.5% commonly quoted for vaginal hysterectomies done without conventional contra-indications.[8] Nulliparity per se does not contraindicate vaginal hysterectomy. It also does not specifically point to any technique of hysterectomy though the incidence of abdominal hysterectomy is as high as 90% in nulliparous women. Careful assessment of the pelvic findings, particularly under anaesthesia, and the operator's ability to deal with it are essential. Experienced assistance, favorable pelvic tissues and importantly, surgeon's inclination to use the vaginal route are important to accomplish identical results as in the multiparous.[17] In the absence of clear contraindications, if the surgeon has doubt about success, it is in the interest of the patient to offer the vaginal route as a trial vaginal hysterectomy[5] and/or utilize laparoscopy purely for evaluation and have a back-up for LAVH or *laparotomy*.

Vaginal Hysterectomy for Previous Surgery

An advocate of vaginal hysterectomy, Heaney[18] believed that a history of previous pelvic surgery precluded removal of the uterus through the vagina. This has proved to be unacceptable in current practice. Coulam and Pratt[19] mention that the chief concern in such cases is the risk of injury to the bladder and difficulty in gaining entry through the scarred anterior cul-de-sac.

Currently 20% or more of deliveries are carried out by cesarean section in most countries. It is therefore conceivable that the surgeon of tomorrow will have increasingly to confront the problem of hysterectomy in patients with one or multiple previous cesarean sections. Carpenter and Silva[20] compared vaginal and abdominal hysterectomies after previous pelvic surgery and they concluded that vaginal hysterectomy following pelvic operation is technically easy and without increase in morbidity (Table 43.1).

Previous abdominal or vaginal surgery per se in the past is not a contraindication to vaginal hysterectomy except a repair of vesicovaginal or rectovaginal fistula and Fothergill's operation in the past.[5] They can be broadly divided into following:

1. Operations performed on the uterus are the most important: cesarean section, hysterotomy, and

myomectomy demand extra care, but do not constitute an absolute contraindication unless they have been performed repeatedly in the past. Ventrifixation, an obsolete procedure, contraindicates vaginal hysterectomy as a result of a mechanical factor.

2. Sling operations for prolapse also make vaginal hysterectomy difficult. Only an experienced vaginal surgeon will be able to cope without laparoscopic assistance.
3. Operations performed on the tubes, ovaries, and broad ligament tissues give rise to a few flimsy adhesions reaching close to the upper pedicle, which are easily separable and do not hinder surgery. They should not be a contraindication.
4. Operations performed on structures or organs other than the genital tract, such as those involving the intestines, gallbladder, and urinary tract (but not the bladder), are not contraindications to vaginal hysterectomy.

Previous vaginal surgery would include any of the following:

1. Operation in the region of the vaginal epithelium.
2. Cervical amputation.
3. Fothergill's operation.
4. Operation through the vaginal epithelium where the peritoneum is entered.

Vaginal Hysterectomy in Obese Women

This was never considered a relative contraindication, nor did it dissuade the vaginal route for hysterectomy. In fact, in the absence of contraindications, greater the obesity, greater should be operator's enthusiasm to take the vaginal route for hysterectomy and greater will be the satisfaction after its completion. Labial sutures and lateral vaginal wall retraction facilitated access and reach to the required pelvic tissues. Oophorectomy at vaginal hysterectomy may not prove easy in some as the vulval pad of fat places the ovaries distally. Preoperative counseling is essential with facilities for laparoscopic assistance or laparotomy, if ovarian removal is desired. Examination under anesthesia will remove any doubts or anxiety in the surgeon's mind and invariably favors the vaginal route especially, when a hysterectomy is without prophylactic oophorectomy. In fact, an obese abdomen should inspire the surgeon to recourse to the vaginal route for hysterectomy, in the absence of contraindication (Table 43.1).

In a large study by Isik-Akbay et al[21] their results showed a lower incidence in fever, ileus, urinary tract infection, and wound complications after vaginal hysterectomy when compared with abdominal hysterectomy in obese women. In addition, vaginal approach in obese women resulted in shorter operative time and required shorter hospital stay compared with the abdominal procedure. Seven of 189 women (3.7%) who underwent abdominal hysterectomy developed wound infection during their hospital stay. Wound complications have been shown to be the major concern in obese patients after abdominal hysterectomy resulting in febrile morbidity and prolonged hospitalization. This study suggests that vaginal approach should be preferred for hysterectomies in obese patients due to significant decrease in postoperative febrile morbidity, ileus, urinary tract infection, operating time, and length of hospitalization. Pitkin[22] studied the effect of obesity in abdominal and vaginal hysterectomy. In his first study focusing on abdominal hysterectomy only, he compared 300 women weighing at least 200 lb with a matched control group of women weighing less than 200 lb. He found that heavy women had significantly increased operative time, blood loss with consecutive transfusion, and a striking 7-fold increase in wound complications, which was mostly responsible for a doubling of postoperative fever and a tripling of length of hospital stay. In the following year, using the same weight cutoff, Pitkin reported his findings for vaginal hysterectomy, with 108 women in each group.[22] He concluded that obesity increased the morbidity of abdominal hysterectomy but not that of vaginal hysterectomy. Larger prospective multicentre studies are necessary to precisely assess the route of hysterectomy in obese women.

Prerequisites Examination under Anesthesia

Findings of examination under anesthesia performed just before the start of hysterectomy, serves as gold standard and enables clear judgment of which route of hysterectomy is appropriate. It is ideal to perform a speculum examination with the patient in lithotomy position using a vulsellum or tenaculum on the cervix and a bimanual examination.[3] Such examination also provides valuable information, about uterine descent and mobility, uterine size, adnexal normalcy and uterus-free pelvic space. This coupled with preoperative sonography findings like adnexal normalcy and uterine volume are very reassuring.

Preoperative Sonography

Preoperative sonography excludes adnexal pathology and confirms the uterine size and dimensions and more importantly total uterine volume. Uterine volume, like uterine size, can be the major guiding factor in deciding a surgical route.[23] Uterine volume can grossly differ in three uteri, with identical fundal height. Preoperatively, it is essential to have a routine urine examination and assess the serum creatinine level to exclude urinary tract infection and silent renal disease respectively. Urography may be required if the uterus is unduly large-larger than 20 to 24 weeks size or there is a large cervical fibroid or massive uterine prolapse.

Trial (Tentative) Vaginal Hysterectomy

Similar to situations in obstetrics, when the surgeon feels that a vaginal hysterectomy is possible but may prove difficult or fail, a trial of vaginal hysterectomy is to be attempted with all preparations to switch over to laparoscopic assistance or laparotomy. Such situations are:uteri greater than 12 to14 weeks' size or with a volume exceeding 300 $cm,^3$ possible adhesions following pelvic surgery in the past, nulliparity, previous surgery or surgery for prolapse or uterine suspension; suspected adnexal pathology and doubt or fear in the absence of contraindications.[3,5] The most important predictive factors for a conversion from vaginal to abdominal hysterectomies are large size of the uterus, doubtful or unexpected adnexal pathology or adhesions, slipped pedicle bleeding, occasionally 'must' prophylactic oophorectomy, the operator's inexperience and inability to utilize laparoscopic assistance.

Place of Laparoscopy

Laparoscopic assistance, only to evaluate is indicated in patients in whom there is reason to fear trauma or possible failure to complete vaginal hysterectomy or during formative period to gain confidence. Laparoscopic evaluation will convert many abdominal or LAVH to vaginal hysterectomy and enhance operator's experience and confidence. Laparoscopic assistance in the form of surgery is indicated in patients to undo the contra-indication or obstacle and permit vaginal hysterectomy.[24]

The best strategy for an indicated laparoscopically assisted vaginal hysterectomy might be treatment of extra-uterine disease and for laparoscopic mobilization of the adnexa followed by vaginal hysterectomy.

Technique of Nondescent Vaginal Hysterectomy

Vaginal hysterectomy involves two important major steps:

I. Getting access to the anterior and posterior peritoneum, i.e. access to both pouches.
II. Severance of all lateral connections of the uterus.

It is necessary to have expertise and great familiarity with the anatomy of the tissues to reach both the pouches and for safely securing all lateral connections respectively.

Narrow bladed and/or long reaching vaginal retractors, in some cases, Jayle's self retaining lateral vaginal wall retractor, different sizes of Sim's and Auvard's heavy speculum are useful. Sutures inserted directly are preferred; the clampless technique saves space occupied by the clamps and provides better grip on tissues though latter is practiced by most. After emptying the bladder, careful bimanual examination under anesthesia confirms the presence or absence of contraindications to the surgery. If required, rectovaginal abdominal examination can be done. The drape is anchored to the perineal skin just above the anus. The cervix is preferably seized by two traction sutures with thick silk instead of a vulsellum. Infiltration of the sub epithelial tissues around cervix with 10-15 ml of 0.005% phenylephrine in saline after receiving clearance from the anaesthesiologistor or 100 to 150 ml of sterile saline to act as an internal tourniquet to reduce bleeding. This facilitates in creating the right planes for dissection and reduces postoperative infection (Fig. 43.3).

Fig. 43.3: Traction sutures on the cervix and infiltration. Traction sutures (black silk No. 2) is preferred to applying vulsellum or Allis tissue forceps

Access to the Anterior Pouch-vesico-uterine Peritoneum

The intraoperative identification of correct planes and space depends on the surgeon's knowledge of surgical anatomy and especially the surgical landmarks as seen in the operative fields. The surgeon takes separate anterior and posterior incisions or has a circumferential incision around the cervix below the line of the bladder. Making the incision anteriorly first and getting access to the peritoneum is more reassuring with less bleeding, than getting access from the posterior edge. For the correct plane of dissection between the bladder and uterocervical surface, note the point of attachment of the vaginal mucosa to the cervix and the bladder bulge above it. The bladder margin on the anterior cervical surface typically forms a crease in the overlying vaginal epithelium, which can be accentuated by in-and-out displacement of the cervix with the vulsellum. The incision is above the border between the smooth cervical mucosa and the vaginal rugae and at the same time below the bulge of the bladder (Fig. 43.4). Retracting mucosa guides the depth of the incision. Strong traction on the cervix and counter pressure on the upper vaginal mucosal margin with Allis forceps will display vesico-cervical ligaments stretching from the bladder to the cervical surface to be divided with scissors. A central approach should be the routine but in those with a history of cesarean section the approach should always be from lateral space. Familiarity with strands of the vesico-cervical ligament acts as a useful guide. A pair of scissors with point directed downward against the uterus now cuts the strands of fibers close to the cervix (Fig. 43.5), which paves the way for the next stroke of the scissors to obtain a proper plane of cleavage between the bladder and the cervix. A bladder retractor or the tip of the index finger - flexed at the first metacarpal joint, pressing hard on the cervix, and pushed upwards, and the uterine body is well felt and seen covered by thin peritoneum - the bladder is separated. A similar motion is carried out using a sponge holder at the time of an abdominal hysterectomy. Avoid oozing by pushing upwards with a gauze covered index finger. A retractor must be placed into the anterior cul-de-sac to retract the bladder superiorly, and to place the lateral uterine attachment on tension to protect the ureters and to facilitate severance of lateral pedicles. A gentle feel with the finger clearly confirms that only a thin pearly white translucent layer of peritoneum is lying as a shiny serosal surface on the

Fig. 43.4: Anterior vaginal mucosa incised, after observing the crease in overlying vaginal epithelium and bladder bulge above it

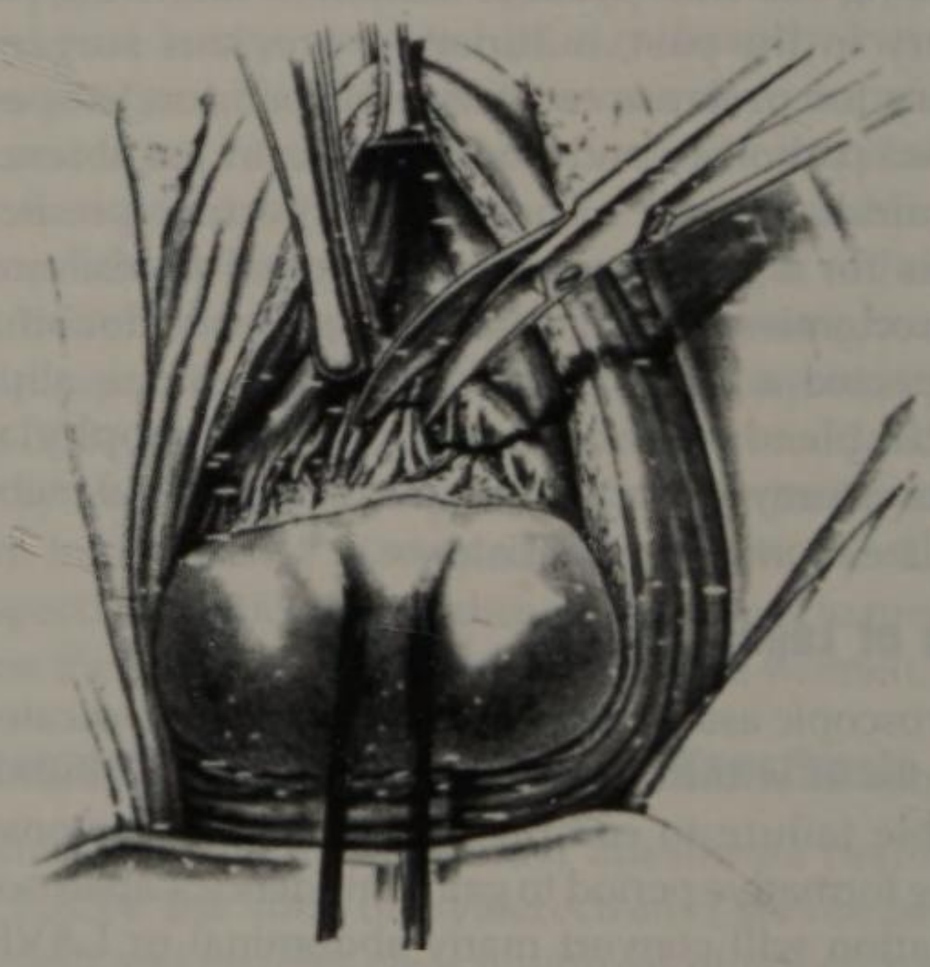


Fig. 43.5: Scissors about to cut and thus separate the bladder from the anterior surface of the cervix to provide a plane for further separation

uterus. This can be easily picked up with a toothed forceps (Fig. 43.6). The peritoneum is now opened (Fig. 43.7). Occasionally, peritoneal fluid escapes freely and the surgeon is tempted to check once again that all is right. If it is not possible to reach the anterior peritoneum at this stage, careful severance of the cardinal, uterosacral,

Fig. 43.6: Vesicouterine peritoneum in front of utero-cervical surface is picked with tooth forceps

Fig. 43.7: Anterior peritoneum, after confirmation, is gently opened to get an access to anterior pouch

vesicouterine ligaments and uterine vessels bilaterally, will lead to the anterior peritoneal reflection, provided angles of the bladder and the bladder are retracted laterally and superiorly away from the uterus by a bladder retractor between the uterocervical surface and bladder.

Fig. 43.8: Uterine fundus is delivered from the posterior pouch of Douglas and pulled in front. Babcock's forceps clearly show the bladder and site of vesicouterine peritoneum to be accessed - the reverse of what is routinely done at abdominal hysterectomy for similar access

When at this stage, if anterior access is difficult the index and middle fingers of the left hand can be inserted through the posterior cul-de-sac and brought to the front of uterovesical reflection so as to permit incision of the thin peritoneum as it rests on the fingers under direct vision. This is followed by severance of upper pedicles. Occasionally with free descent, uterine fundus is delivered from the posterior pouch of Douglas and pulled in front. Babcock's forceps is applied to the bladder and site of vesicouterine peritoneum is accessed - the reverse of what is done at abdominal hysterectomy for similar access (Fig. 43.8).

During early parts of the learning curve or in case of the occasional difficulty, bladder sound or metal catheter or instilling a few milliliters of methylene blue in the bladder can act as a guide to avoid risk and get the plane of dissection.

Uterocervical Broad Ligament Space

In cases with suspected anterior uterine adhesions like in a previous caesarean section or myomectomy, a surgical window or Sheth's uterocervical broad ligament space can provide required access to the uterovesical peritoneum during vaginal hysterectomy[25] or for that

matter at abdominal as well as laparoscopically assisted hysterectomy.

Based on observations in women with cesarean section it was seen that if the bladder is adherent, it is always in the central three -fifth and not in the lateral one-fifth (Fig 43.9). MRI studies at the isthmic level through different planes show a distinct vacant space medial to the line joining the maximally bulging uterus above and the cervix below, with its continuity medially between the uterocervical surface and the bladder, until they come extremely close to each other in the midline[26] and continue laterally between the two leaves of the broad ligament (Figs 43.10 and 43.11).

This nonadherent portion of bladder can be easily approached for separation through Sheth's uterocervical broad ligament space or surgical window. Separation is from lateral to medial, occasionally depressed adherent scarred surface acts as a guide. Familiarity this and normal serosal surface of uterus are helpful. The author as a rule has been utilizing this space for the past15 years to obtain access to the uterovesical peritoneum in all cases with a history of cesarean section in the past without bladder trauma. The same space is often utilized at abdominal hysterectomy or laparoscopic hysterectomy when separation of the bladder in its central portion is unfavourable. Monaghan, a noted gynecologic oncologist finds this space useful for getting access to the vesico-uterine peritoneum.

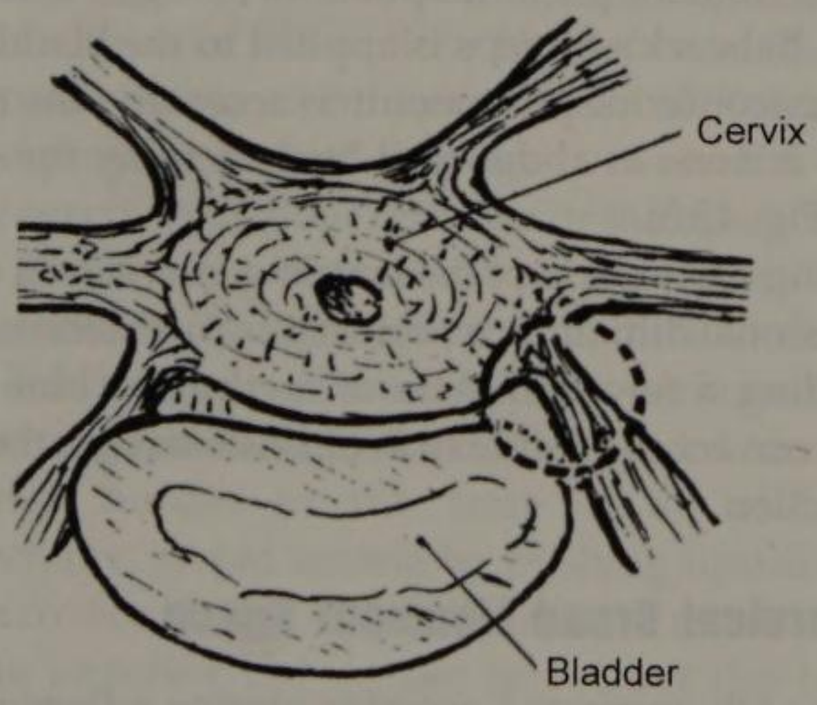


Fig. 43.9: In the lateral 1/5 of the uterovesical fold, a window or space - uterocervico broad ligament space (circle of dotted lines), permits entry to begin the bladder separation from lateral to medial aspect

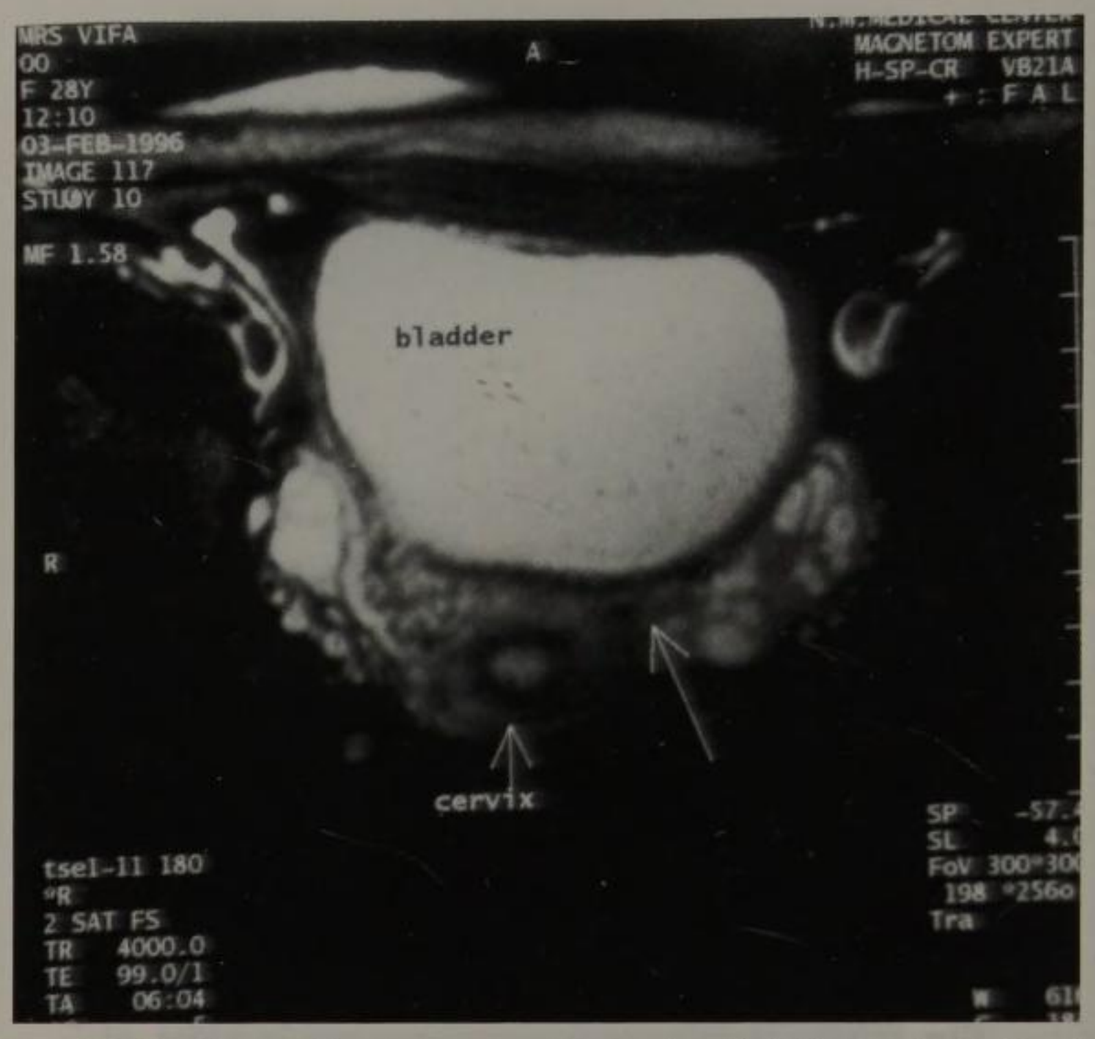


Fig. 43.10: Magnetic resonance imaging (MRI) study distinctly shows the presence of available space or surgical window between bladder and underlying cervix

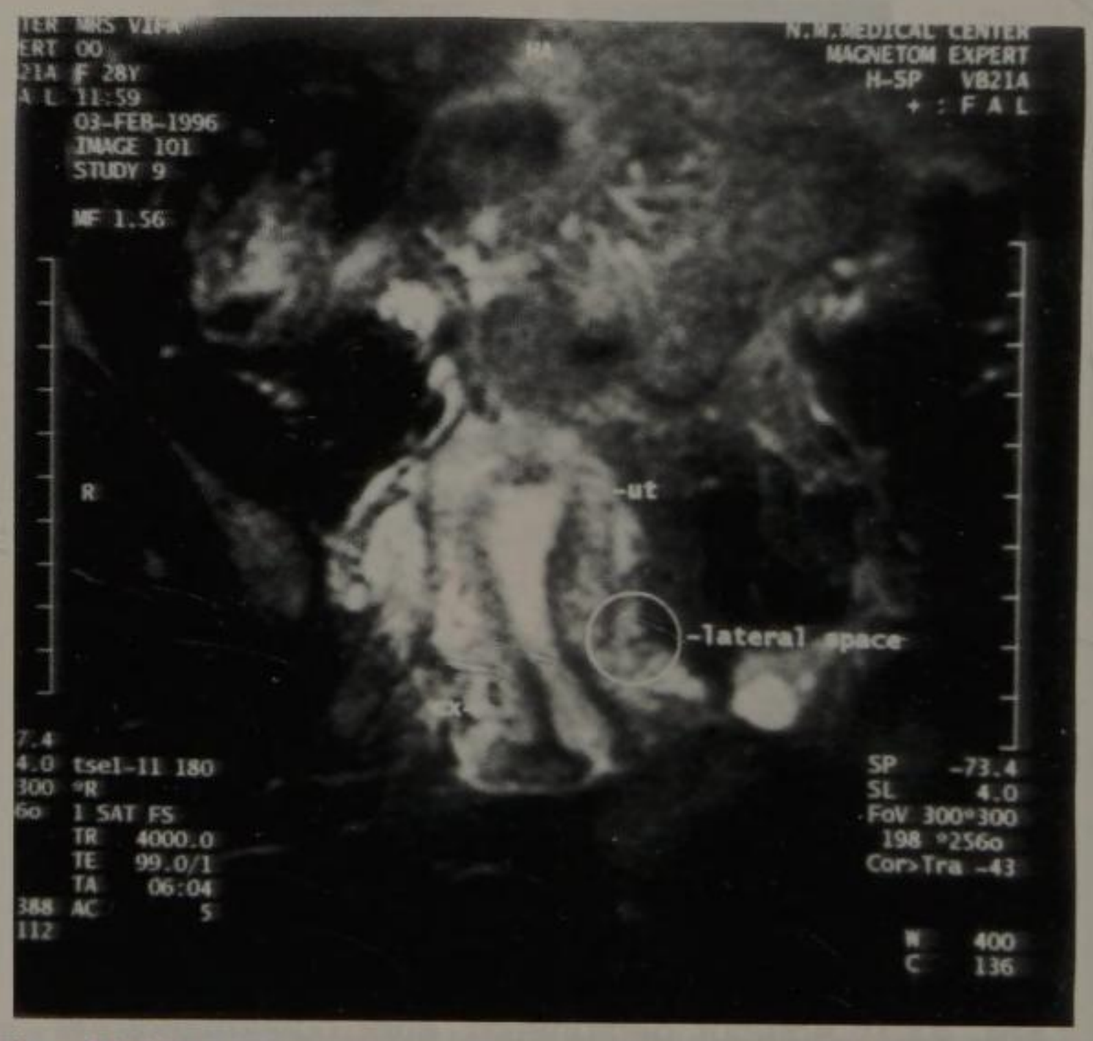


Fig. 43.11: MRI study confirming the presence of a surgical window to facilitate the entry (uterocervical broad ligament space)

Surgical Technique in Previous Cesarean Section

During vaginal hysterectomy, after the vaginal mucosa has been incised, an anterior bulge sloping laterally on the cervical surface is seen. Dissection is made lateral to

this, first by scissor between the cervix and bladder to enter the uterocervical space, making room for the finger (Fig. 43.12), then insinuating upward and laterally beyond the lateral uterocervical border and enlarging the plane to enter into the continuing space between the two leaves of the broad ligament. The space is thus entered by sharp and blunt dissection and is gradually enlarged by the finger.

After reaching the area between the uterocervical surface posteriorly and the bladder anteriorly and using gentle traction medially with Babcock forceps on the free bladder, it is simple to sweep the finger medially and thus break the midline adhesions bluntly (A video tape demonstrating the surgical anatomy and technique is available on request from the senior author) (Fig. 43.13) and the bladder is separated from the uterocervical surface. The bladder usually lies free or not in close proximity to the uterocervical surface in its lateral one fifth, in contrast to its central three fifths - that is, the lateral one fifth of the bladder on either side is easily separable. Getting a free edge of the bladder is an essential step for further separation. In those cases where difficulty is encountered in separating the bladder completely, a similar lateral approach from the opposite side is used to complete the separation of the bladder from the uterocervical surface. Thus, the uterocervical broad ligament space acts as a surgical window to provide a plane of cleavage (video demonstration provided).

Fig. 43.12: Sharp dissection near the lateral uterocervical margin at vaginal hysterectomy provides the described space on the uterocervical surface to separate the bladder lying anteromedially with finger

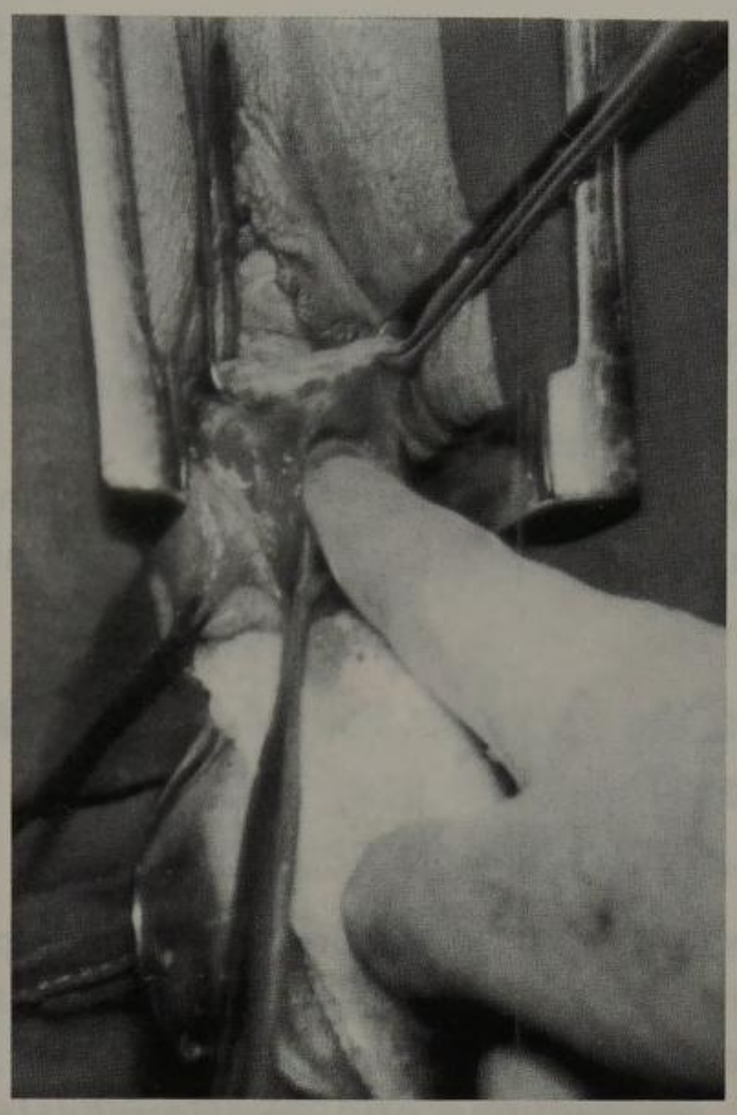


Fig. 43.13: At vaginal hysterectomy tip and gradually terminal phalanx of the index finger is placed in the uterocervical broad ligament space

The same space is reached and used during abdominal hysterectomy by cutting the anterior leaf of the broad ligament just lateral to the bladder at the level of the loose vesicouterine fold of peritoneum. The free uppermost lateral portion of the bladder is held with a Babcock forceps, and the bladder is separated medially. As in vaginal hysterectomy, if separation is difficult, approaching from opposite side will complete the separation. Thus, in the abdominal route, the space is reached by dissection from above downward and from lateral to medial, exactly opposite in direction to what is done in vaginal hysterectomy.

Examination under anesthesia is the best guide to the surgical feasibility of vaginal hysterectomy. It is easier to open the posterior pouch first in patients with previous cesarean sections as identification of this is easier. This step allows one to secure the uterosacral pedicles and Mackendrots ligaments, thus allowing the uterus to be pulled down even further and permitting access to deeper areas, which were previously inaccessible, including the uterovesical fold of the peritoneum.

While dissecting the bladder upwards off the cervix, tactile sensation was very important. If the surface of the anterior uterine wall can be palpated through a thin layer of peritoneum, or the thin layer of peritoneum had its normal look and/or normal feel, it confirmed that the

bladder had been adequately dissected off and that one could proceed safely with opening the uterovesical pouch. Scarred and/or gently dented, irregular uterine surface easily draws operator's attention. Learning to be familiar with this is helpful. The uterovesical fold of the peritoneum is almost certainly identified once the level of uterine vessels was reached. Extreme care is exercised to keep the bladder away using a retractor. If, however, soft tissue structures are rolled under the finger, then further careful dissection is needed to prevent damage to the bladder.

Access to the Posterior Pouch: Recto-vaginal Peritoneum:Technique does not Differ in Nullipara, Past Pelvic Surgery or Obesity

This access was once the primary method of peritoneal evaluation in infertile women and tubal sterilization, and to date remains a convenient and effective route for retrieval of myomas and ovarian cysts during laparoscopic surgery. The cervix is drawn anteriorly and upwards using traction sutures or a vulsellum, whereas the posterior vaginal wall is retracted with a Sims' speculum. Next, the uterosacral ligaments are noted and the junction of the cervix with the epithelium of the posterior vaginal fornix is identified by pushing the cervix slightly inwards and looking for the characteristic transverse rugosity or crease.

A depression is seen between the two uterosacral ligaments, which indicate the situation of the floor of the pouch of Douglas. In most, it lies about 3 to 4 cm from the external os and the pouch of Douglas lies approximately 1 to 2 cm posterior to or below the first rugosity.

For access to the POD, the posterior vaginal mucosa is incised in one of the two ways:

1. The experienced surgeon may give a bold transverse cut of 3 to 4 cms just above Allis forceps firmly grasping a chunk of vaginal mucosa including underlying the peritoneum, 1 to 2 cm posterior to or below the first rugosity or crease on the vaginal mucosa (Fig. 43.14). This straightaway gives gratifying entry into the peritoneal cavity
2. Gently incise 3 to 4 cm of vaginal mucosa at the same site and the posterior vaginal fornix is exposed. The vaginal skin is then separated with a swab on a sponge holding forceps or the forefinger, to open the cellular tissue between the vagina and rectum and to separate the vagina from the rectum. With a swab firmly pressing and pushing away the tissue from the posterior cervical surface and backwards, this provides the space that distinctly displays bulging thin peritoneum or bulging perirectal tissue containing the peritoneum (Fig. 43.15). Palpating

Fig. 43.14: For an access to pouch of Douglas, Allis forceps is holding vaginal mucosa 1-2 cm below the first rugosity and scissors is ready to cut the vaginal mucosa

Fig. 43.15: Posterior vaginal fornix is exposed, permitting to open the cellular tissue between the vagina and rectum and thus provide bulging peritoneum to get an access to pouch of Douglas

fingers or experience confirms that the thin bulging translucent tissue is indeed peritoneum. The thin cellular tissue and subjacent peritoneum is picked up in dissecting forceps and opened carefully with scissors, to avoid injury to the rectum. Peritoneal entry is usually heralded by the efflux of a small amount of straw-coloured peritoneal fluid and the characteristic, shiny, white appearance of the peritoneum that lines the cul-de-sac and posterior serosal surface of the uterus (Fig. 43.16). The posterior cul-de-sac is explored with the index finger to exclude adhesions or other pathology and for considering the need to convert the surgery to abdominal approach or to take laparoscopic assistance. Bleeding from the posterior vaginal cuff must be controlled and weighted retractor of appropriate width and length be placed in the cul-de-sac.

Usually a smooth opening of the pouch heralds smooth sailing for the hysterectomy; in fact, obtaining entry to both the pouches is like a trump card for the surgeon. Anyone wanting to learn vaginal hysterectomy will need to be familiar with the anatomy for access to the pouches. Anyone who masters this access will master vaginal hysterectomy.

Fig. 43.16: Distinctly shows shining peritoneum through the accessed pouch of Douglas

Severance of Uterine Supports and Lateral Connections

Three to five pedicles are to be secured on both sides depending on whether ovaries are to be conserved or removed. . If the ovaries are to be preserved, the tubo-ovarian and round ligament are secured as one pedicle. If not, the infundibulo-pelvic and round ligament are secured as two separate pedicles, the uterine vessels, the cardinal and uterosacral ligament complex pedicle as one or as two pedicles, approximated later as one. The operator's left index finger enters the peritoneal cavity behind the cardinal and uterosacral ligaments and puts them on stretch. The surgeon has the choice of applying a clamp to the uterosacral ligament, dividing it and securing the pedicle with a No.1 Vicryl suture, or placing a direct suture to pierce the upper limit of the pedicle with a needle, to tie and cut it medially. The author has used this suturing technique in all cases, i.e the clampless technique[3,5] (Fig. 43.17). (Also see chapter 39)

A suture on regular needle or pedicle needle loaded with vicryl is passed from front with the left finger in the peritoneal cavity behind the pedicle and with its medial surface of finger in close contact with the lateral

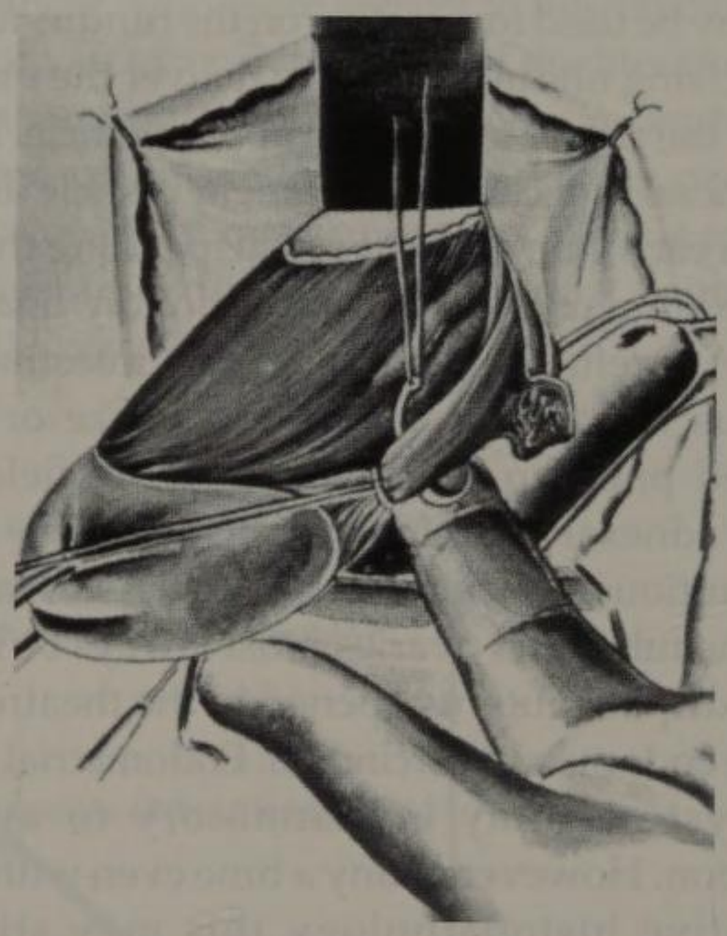


Fig. 43.17: Suture technique (clampless method) shows a finger hooking around the uterosacral ligament

border of the uterus. The gloved finger easily senses the progress of the needle and is reflexly withdrawn as the needle moves forward, and presents its tip for needle holder and thus surrounds the ligament with a suture, away from the cervix and close to vaginal mucosa. Alternatively, the same pedicles are clamped, cut and transfixed. The pedicles are uterosacral - Mackendrots complex, uterine artery, round ligament and infundi-

bulo-pelvic ligament or round ligament along with tube and utero-ovarian ligament. The uterine vessels, which may include ligamentous tissue, are secured in a similar fashion. There after, if the open mouth of the cut end of the uterine artery can be seen or uterine vessel with surrounding ligamentous tissue is sutured and secured again, i.e. doubly securing but without use of clamp. After the uterine vessels are ligated on each side and threads cut short, the remaining portions of the broad ligament, including the anterior and posterior peritoneum of the broad ligaments on each side are secured and the level of round ligaments is reached. If the operator's fingers at this stage can easily reach the fundal surface, it is apt to deliver the uterus. If not, after rechecking on the uterine size and uterine volume further lateral severance or debulking is required, till the fundus is well felt or else the alternative is to bisect the uterus from cervix upwards and deliver each half to complete the hysterectomy. The uterus is delivered from anterior or posterior pouch, though it is simpler, from the spacious posterior pouch. Bulldog vulsellum or large towel clip or Leahey thyroid clamps may be used for traction on the fundus for uterine delivery. Using undue traction to deliver the uterus puts strain and the risk of tearing the upper pedicle. Ligatures on uterosacral and cardinal ligament pedicle and upper pedicle on each side are held for suspending the vaginal vault. The surgeon should always doubly ligate all the pedicles. A careful watch for adherent intestine close to the fundus is necessary. A Roller gauze or recently introduced pneumo pack will keep the field clear.[27] Releasing adnexal adhesions vaginally is easy but must be done cautiously and gently. Before the start of surgical closure, the tubes and ovaries must always be inspected and the extirpated uterus opened in the theatre in order to exclude endometrial carcinoma. Endometrial sampling before hysterectomy is mandatory to avoid this complication. However, many a time even with a benign preoperative histopathology this may still occur. Suspicious findings require recourse to frozen section histopathology. If this is found, both appendages must be removed. The basic principles of meticulous haemostasis, copious irrigation, gauze or mop count and elimination of dead space and devitalized tissue in wound closure should be observed. Since the last few years, we prefer to keep the peritoneum open and reconstitute it only if hysterectomy is followed by bladder neck suspension or sacrospinous fixation. If peritoneum is closed purse string closure through transfixing upper and lower pedicles with required bites on uterovesical and pouch of Douglas peritoneum, should easily allow all the pedicles to be extraperitoneal and provide watertight closure. If peritoneum is kept open, the vaginal cuff must be closed. Surgeon has an option to close the peritoneum and if he does, he has the option to keep vault open, though preferably this is to be closed. After the uterus is removed, restoration of normal anatomy and support is a major concern. The vaginal vault is closed using the secured pedicles, as anchoring supports. The ideal method is lower pedicle comprising of uterosacral and cardinal ligament complex of two sides are approximated to each other and then after anchored to anterior vaginal wall margin near its angles, keeping long ligature uncut. If salpingo-oophorectomy is performed, ligature, on both sides, holding infundibulo-pelvic ligament is approximated and tied to that holding round ligament. Ligature holding round ligament is next approximated and tied to that of opposite side and anchored to posterior vaginal wall margin near its angle on both sides and left uncut. If only oophorectomy is done, ligature is cut short. In absence of prophylactic oophorectomy, ligature holding upper pedicle comprising of round ligament, tube and utero-ovarian ligament is anchored to posterior vaginal wall margin near its angle on both sides and left uncut. Not crisscrossing ligatures and pedicles from one side to the other will avoid bringing the ovaries towards the midline. Additionally, it is worth approximating the distal part of two uterosacral's, include intervening posterior peritoneum and obliterate the dead space. Support for the vaginal vault and upper posterior vaginal wall especially must be such as to secure permanent normal position for the vaginal walls. As peritoneum is not routinely closed, I prefer to close vaginal mucosa with continuous suture using 2-0 vicryl. Having anchored upper and lower pedicles to vaginal margins, ligatures on each side anchoring anterior and posterior vaginal walls are tied to each other and this visibly pulls up vaginal vault. We must approximate the uterosacral and cardinal ligament complex of the two sides to each other and use these sutures to anchor to the anterior vaginal margin near angles. Similarly, in an oophorectomised case, approximate the round ligament pedicles to each other and use this to anchor posterior vaginal wall margin near its angles. When ovaries are preserved, each upper pedicle is anchored, similarly to the posterior vaginal wall separately on the same side. Rarely, in a nullipara, limited exposure requires a median episiotomy or a small Schuchardt's incision, which is sutured. There is no need

for a vaginal pack unless the field is oozy. Instruments and assistance play a very important role. An indwelling catheter for 24 hours helps the patient, nursing and resident staff, but this is optional.

Debulking

Debulking is gratifying and easier in a myomatous rather than an adenomyomatous uterus. Debulking either by myomectomy and/or by, morcellation is to be carried out only after and never before the uterine vessels are properly secured, so that bleeding, if at all, is negligible.

Large size demands debulking. Surgically, enucleation of myoma (Fig. 43.18), morcellation of adenomyotic walls, bisecting cervix or from cervix to fundus, coring, Lash's technique and/or medical debulking using GnRH agonist's[28] are available to pick and choose from. In our experience, when uterine enlargement is the only impediment to removal of a relatively mobile uterus, it is the critical uterine size that predicts morcellation ranging from 10-12 weeks gestational equivalent or uterine volume of 250 to 300 $cm,^3$ depending on pelvic factors in form of ease of descent, laxity of tissues, all-round uterus free space, myoma location, adnexal normalcy and importantly operator experience. However, if the uterus is relatively immobile, morcellation is needed even with a smaller uterine size to deliver the fundus and complete the hysterectomy.

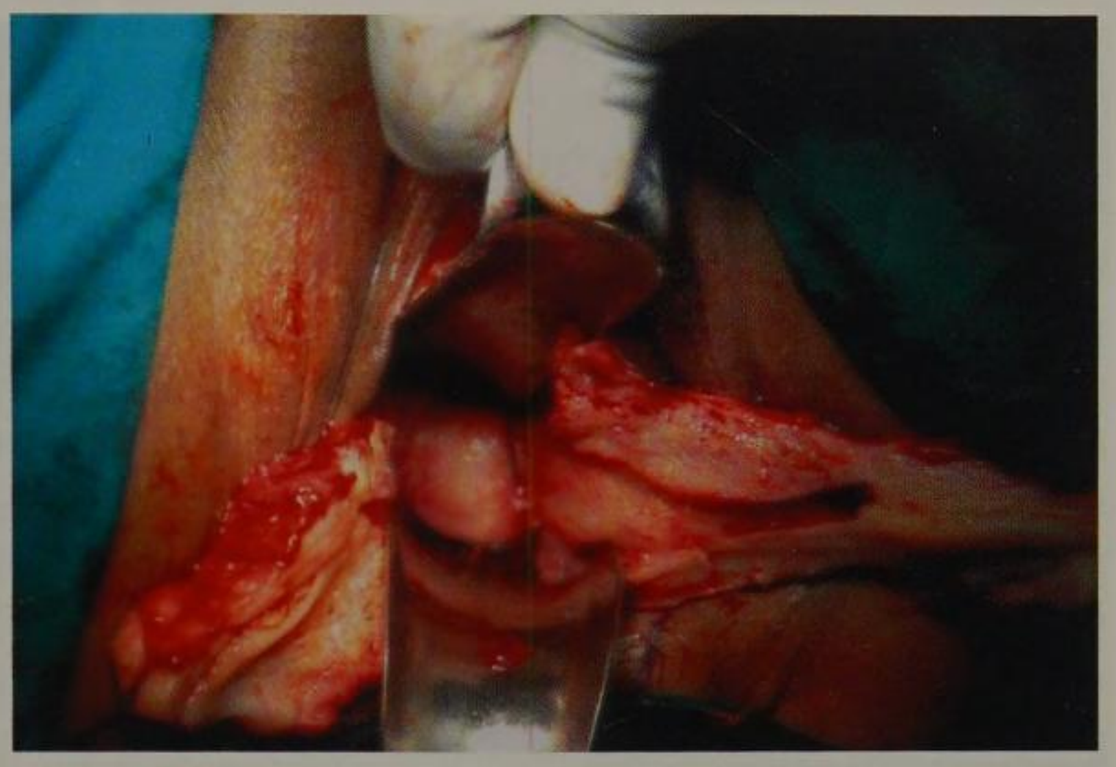
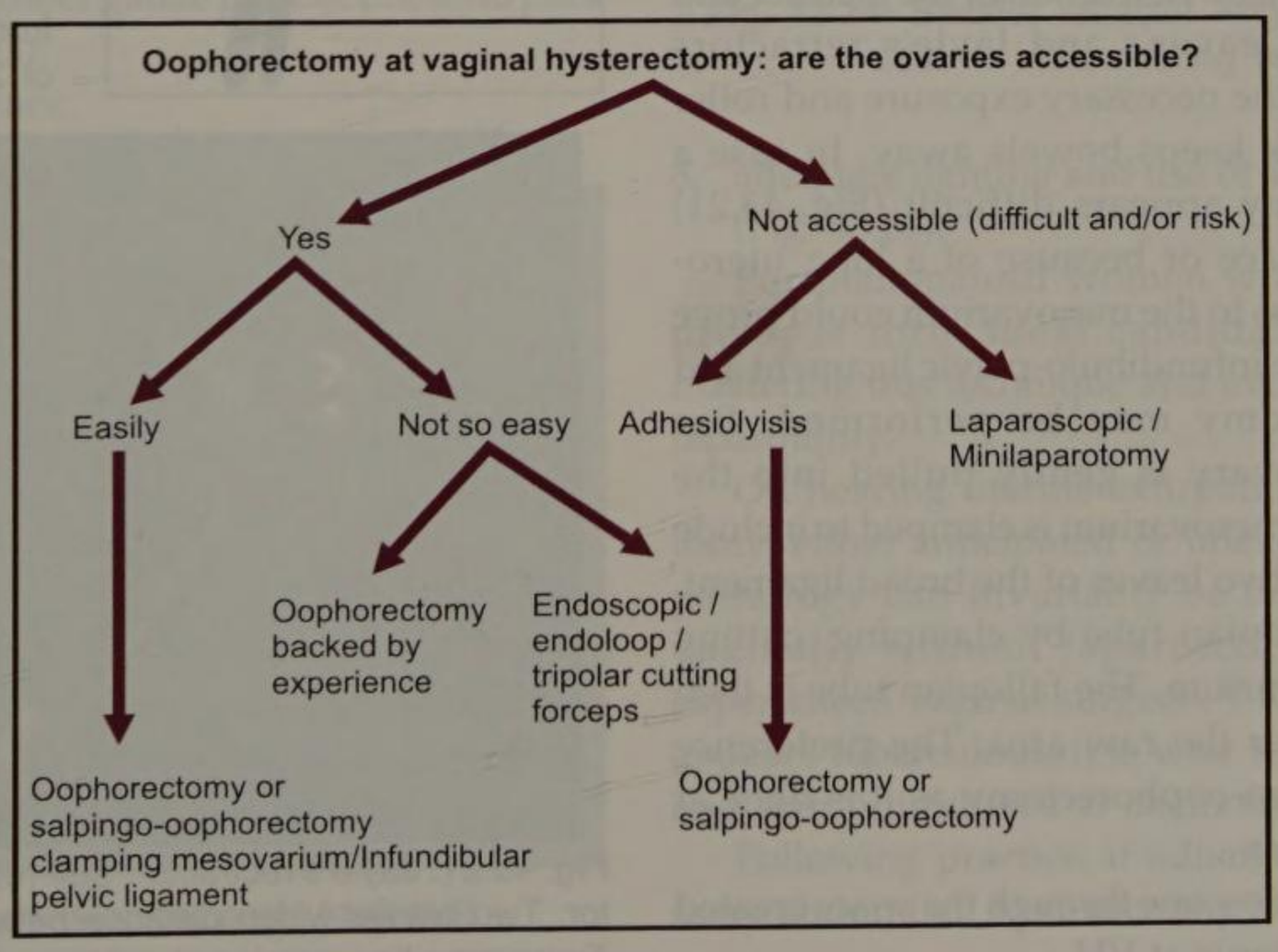


Fig. 43.18: Uterus of 400 cm^3 volume is bisected to get an easy access to 7 x 5 cm myoma for enucleation

Prophylactic Oophorectomy or Salpingo-oophorectomy at Vaginal Hysterectomy

The need for prophylactic oophorectomy becomes obvious when one retrospectively studies women of ovarian cancer, who were subject to hysterectomy in the past.[29] From an extensive review of the literature, Jacobs and Oram[30] support routine prophylactic oophorectomy at the time of pelvic surgery and thus prevent the occurrence of 7% of ovarian cancers. This is mandatory if there is family history of ovarian cancer (Flow chart 43.1).

Flow chart 43.1: Algorithm for prophylactic oophorectomy ATVH



The following is the technique for removing the ovaries vaginally during a vaginal hysterectomy.[3] The uterus is completely severed from all its pedicles on one side. The surgeon now has the choice of performing either an oophorectomy or a salpingo-oophorectomy. The uterus hinges on the contralateral upper pedicle, which consists of the round ligament, utero-ovarian ligament, and the fallopian tube. In order to provide easy access to the infundibulo-pelvic ligament for performing salpingo-oophorectomy, the round ligament with the part of the broad ligament inferior to it must now be separately clamped, cut and ligated as laterally from the uterus as possible (Fig. 43.19). In other words, one should never include the tube and utero-ovarian ligament in the same pedicle as that of the round ligament. Thus, the uterus with the tube, ovary and mesovarium is left hanging on the support of the infundibulo-pelvic ligament only. Based on accessibility of the infundibulo-pelvic ligament, if salpingo-oophorectomy is possible a specially devised clamp 'Sheth's adnexa clamp' (Fig. 43.20) is applied above the round ligament stump to include the full length of the infundibulo-pelvic ligament.[31] Gentle handling of tissue is essential at this time to prevent tearing and bleeding. The operative field is then well inspected and sutures are placed. The infundibulo-pelvic ligament is transfixed, and doubly ligated with 1-0 Vicryl. While it is essential to be aware of ureteric proximity, there is no need for undue anxiety as the ureter is distally placed by at least 4 cm to 5 cm. The other ovary is then removed in the same manner, by salpingo-oophorectomy after freeing the round ligament. Retraction of the bladder and vaginal walls with Deaver's and Jayle's retractors respectively provides the necessary exposure and roller gauze or pneumopack keeps bowels away. In case a salpingo-oophorectomy appears difficult (Fig. 43.21) because of limited space or because of a long utero-ovarian ligament, access to the mesovarium could prove easier than access to the infundibulo-pelvic ligament and a simple oophorectomy may be performed. For oophorectomy, the ovary is gently pulled into the operative field and the mesovarium is clamped to include the space between the two leaves of the broad ligament, keeping away the fallopian tube by clamping, cutting and ligating the mesovarium. The fallopian tube is then brought down to cover the raw area. The preference should be for a salpingo-oophorectomy as it is done at abdominal hysterectomy.

Magos[32] used an endoscope through the space created by extirpation of the uterus at VH.

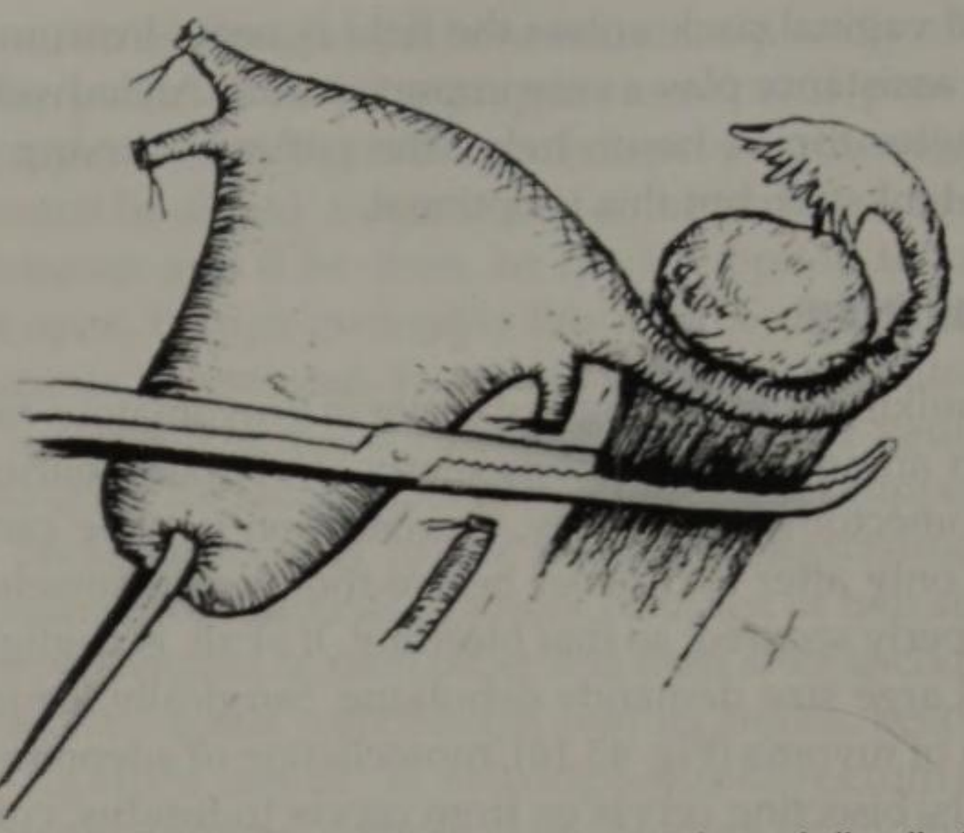


Fig. 43.19: Round ligament is cut separately and distally from the uterus to facilitate the clamping infundibulo-pelvic ligament and perform salpingo-oophorectomy

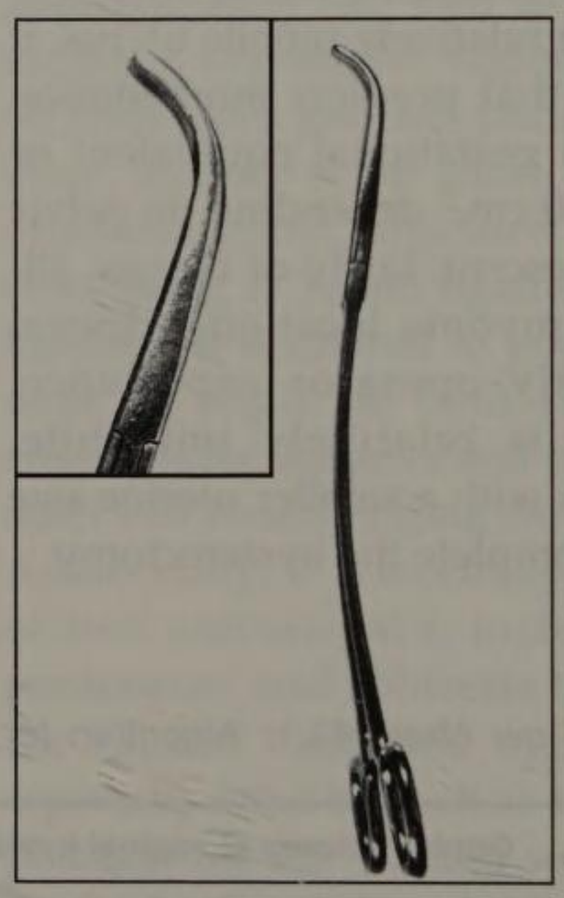


Fig. 43.20: A special clamp (Sheth's adnexa clamp, Cooper's Surgical, USA) for the infundibulo-pelvic ligament or mesovarium. Clamp has a favourable curve beginning at 1 cm from the tip for the distance of 2 cm

Fig. 43.21: Jayle's rectractor: Self-retaining vaginal wall retractor. Two blades widen distance between lateral vaginal walls. Transverse bar remains close to urethra and pubic symphysis

Hefni[33] used stapler or bipolar forceps or endoloop for successful bilateral oophorectomy with vaginal endoscopic approach. Surgeons experienced with Roeder's loop may use it freely to catch the mesovarium and excise the ovary.

The vaginal techniques used above is preferred to laparoscopic oophorectomy, by bipolar coagulation, pre-tied ligature placement, and automatic stapling devices. Flow chart shows the course of action to be taken in deciding whether to perform oophorectomy at VH.

Sheth[34]reported 95% success while performing prophylactic oophorectomy at vaginal hysterectomy in 740 cases. Hefni and Davies[33] have successfully performed oophorectomy vaginally at vaginal hysterectomy in great majority and is superior to other approaches. Cengiz et al used laparoscopic evaluation followed by vaginal hysterectomy using Heaney technique in 64.7% and salpingo-oophorectomy using Sheth's technique.[35]

Certain prerequisites which should be satisfied in order to safely perform oophorectomy at VH include.

1. Experience of vaginal hysterectomy.
2. Normal tubes and ovaries.
3. Easy accessibility and free mobility of the ovaries.
4. Securing and cutting round ligament separately and as laterally as possible, similar to performing a salpingo-oophorectomy at abdominal hysterectomy.
5. Use of a specially devised clamp (Sheth's adnexa clamp) (Fig. 43.20).
6. Better exposure with a steep Trendelenburg position, and by using a long roller gauze pack or pneumo pack (Figs 43.22 and 43.23).
7. Experienced assistance.

Fig. 43.22: Pneumo-surgical pack (deflated)

Fig. 43.23: Pneumo-surgical pack (inflated)

Fig. 43.24: Bladder retractor with fibreoptic light facility adds to vision during oophorectomy

8. adequate lighting and use of a fiberoptic light source (Fig. 43.24).

Postmenopausal women with 3rd degree uterine prolapse form ideal candidates for learning and mastering this technique and avoiding use of LAVH or laparotomy.

On nearing uterine extirpation at vaginal hysterectomy, either anticipated or unexpected benign adnexal pathology can invariably be dealt with successfully vaginally without laparoscopic assistance by the experienced vaginal surgeon.[36] Rarely, if the pathology appears tuberculous, it is wise to minimize the surgery and start antitubercular chemotherapy.

Following practice, if adhered, will reduce unnecessary abdominal hysterectomy and LAVH.

Table 43.2: Practical steps to assist and promote oophorectomy at VH

1. Separate and lateral excision of round ligament for easier access to infundibulo-pelvic ligament for salpingo-oophorectomy (similar to abdominal hysterectomy).
2. If salpingo-oophorectomy is difficult, perform oophorectomy
3. If 1 and 2 are not possible, endoscopic excision vaginally.
4. In obese women longer instruments and fibre optic light source will facilitate oophorectomy

CONCLUSIONS

In conclusion, in absence of other contraindications, nulliparity, obesity and previous abdominopelvic surgery should never deter the gynecologist from performing hysterectomy via vaginal route. Vaginal route should be the primary route for hysterectomy. Nulliparity, obesity and previous abdominopelvic surgery need to be respected surgically by a gynecologist and extra care taken after applying the gold standard for the decision making namely absence of contra-indications and favorable findings of examination under anaesthesia.

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44

Laparoscopic and Vaginal Adnexectomy

Alka Kriplani, Sumana G, Pradeep Kumar Garg

INTRODUCTION

Hysterectomy is the second commonest surgery done in women all over the world with almost 600,000 women undergoing the procedure every year in the United States. Of the various approaches, the abdominal route remains the most common. A recent report from the United States, states that the abdominal route was used in 75% and vaginal route in 25%.[1] The VALUE national hysterectomy study from UK reported 37,298 cases of which 67% were by abdominal, 30% were vaginal and 3% were by laparoscopic route.[2] Reich in 1989 first published the technical feasibility of laparoscopic assisted vaginal hysterectomy and it soon gained immense popularity amongst gynaecologists. Laparoscopy began to replace both the other routes with apparent advantages. However, trends have begun to change with various studies highlighting the current role of laparoscopic assistance in hysterectomy.

In a systematic review and meta-analysis of randomized control studies involving 27 trials and 3643 participants, it was concluded that vaginal hysterectomy (that is safely done) is preferable to abdominal hysterectomy where possible. Where vaginal hysterectomy is not possible, laparoscopic hysterectomy is preferable to abdominal hysterectomy, although with a higher possibility of bladder and/or ureteric injury. It was seen that vaginal hysterectomy had clear benefits as regards to earlier return to normal activity, lesser urinary tract injury, shorter operating time and hospital stay. The earlier notions that laparoscopy allows better identification of pelvic disease and ensures meticulous haemostasis were not statistically proven. It was also questionable if an increased detection of unexpected disease had any significant clinical outcome.[3]

The number of oophorectomies done with hysterectomy has also been increasing, an incidence of about 50% reported in 1990. 37% of women below 45 years and 68% of women over 45 years of age now undergo bilateral oophorectomy. A gynaecologist should therefore, have adequate knowledge of choice of appropriate route of oophorectomy with hysterectomy. One of the main indications for using an abdominal approach or laparoscopic assistance in vaginal hysterectomy is need for adnexal removal. Expert vaginal surgeons today quote a successful oophorectomy rate of 90% to 97.5% at vaginal hysterectomy.[4] But this is not the case with all surgeons and adnexal removal is often the sole indication to choose the abdominal route. This chapter attempts to review the various modes of adnexal removal during vaginal hysterectomy and the current role of laparoscopy.

Indications for Laparoscopic Assistance for Adnexectomy

Vaginal hysterectomy in expert hands is possible in 97% of cases planned for hysterectomy for a benign indication; which may reduce to 94% when oophorectomy is indicated.[5] Traditional contraindications for vaginal hysterectomy and, therefore, indications for laparoscopic assistance for adnexal management are shown in Table 44.1. [6]

Surgeons with excellent expertise in vaginal surgery may achieve successful outcome in many of the above indications but severe associated disease may pose a problem to any expert. A surgeon should hence, not hesitate to use judicious laparoscopic assistance in the interest of the patient. The various routes of adnexal removal in vaginal hysterectomy are: vaginal oophorectomy; laparoscopic adnexectomy and vaginal laparoscopy.

Table 44.1: Indications for laparoscopic assistance for adnexectomy

1. Poor access to ovaries.
2. Nulliparity without descent (surgeons with good expertise in vaginal surgery have reported a success rate of 96.2% in nullipara; thus questioning this indication).
3. Previous pelvic surgery.
4. History of pelvic inflammatory disease.
5. Moderate to severe endometriosis.
6. Adnexal masses.
7. Known pelvic adhesions.
8. Restricted mobility of the uterus.
9. Stage I endometrial cancer.
10. Uterine size > 280 gm.

VAGINAL OOPHORECTOMY

Vaginal oophorectomy adds a mean time of 23 minutes to the procedure of vaginal hysterectomy.[7] This is often thought to be a risky procedure owing to fear of restricted access to the ovaries and inadequate visibility of the adnexa during conventional vaginal surgery.

Conventional Technique

The decision to perform oophorectomy is reviewed after the cornual pedicle comprising of the utero-ovarian ligament and fallopian tube has been cut on one side. The uterus now hinges on the opposite upper pedicle. The surgeon then makes a choice whether oophorectomy or salpingo-oophorectomy needs to be done. The tube may be removed if possible. The round ligament is incised as laterally as possible. This provides easy access to the infundibulopelvic ligament. With adequate exposure, traction is given and a clamp is applied to this ligament and ligated. The contralateral tube and ovary are then removed. If salpingo-oophorectomy appears to be difficult because of limited space or inaccessible ligament, a simple oophorectomy can be done by clamping the mesovarium.

A specially devised clamp called the Sheth clamp[8] (reader referred to chapter 43) has a curve of 2 cm beginning 1 cm from its tip. It facilitates and accommodates the infundibulopelvic ligament which is then well secured with vicryl suture. Sheth has reported a series of 740 successful vaginal hysterectomies in which oophorectomy was possible in 94% of cases with this specially devised clamp. In addition oophorectomy at vaginal hysterectomy did not add to any morbidity.

Newer Techniques

Roeder's Loop/Ovarian Stapling

1. Access to ovaries by Roeder's loop used in laparoscopic surgery to get around the ovary can be used.
2. An endoloop along with the Sheth's clamp has also been successfully used.
3. Stapling of the ovarian vessels.

Vaginal attempt at oophorectomy may fail in cases of tubo-ovarian adhesions, inaccessibility,, poor assistance or in any of the previously mentioned contraindications for vaginal hysterectomy.

Kovac et al devised a grading system that predicts the probability of ovarian removal by vaginal route.[4]

Grade 0: No descent of ovaries Infundibulopelvic ligament has little or no stretchability. Ovaries are positioned at the lateral pelvic wall at or above the ischial spines and cannot be brought by traction into the long axis of the vagina.

Grade I: Ligament stretchability brings the descent of the ovaries to the long axis of the vagina with traction midway between the ischial spines and midvagina.

Grade II: Traction brings the ovaries to midway between midvagina and hymenal ring

Grade III: Traction brings the ovaries beyond the hymenal ring.

It is presumed that any ovary that is Grade I or more should be accessible and visible for transvaginal removal. In many cases the ovaries are presumed to be inaccessible by hesitant surgeons when they are actually reachable. The authors propose that this objective method of assessment would aid all surgeons before embarking on any other route for oophorectomy.

The advantages of vaginal oophorectomy and hysterectomy are already mentioned in comparison with other routes. No outcomes are significantly worse for vaginal hysterectomy than any other method. Thus, vaginal hysterectomy is preferred whenever possible. It thus appears that laparoscopic assistance is not useful in performing vaginal hysterectomies with prophylactic bilateral oophorectomies and in patients without other related disorders (endometriosis, adhesions, adnexal anomalies).[9]

LAPAROSCOPIC ADNEXAL REMOVAL

Success at vaginal surgery depends upon the expertise of the surgeon. A gynaecologist comfortable with vaginal surgery would find fewer indications for the abdominal route than a surgeon of lesser expertise. There is a general agreement all over to transform an abdominal hysterectomy into a vaginal one. In comparison with abdominal route, laparoscopy has clear advantages as in being minimally invasive, lesser hospital stay, earlier return to normal activity, patient comfort, lesser wound infection and cosmesis. Thus by using laparoscopic assistance at vaginal surgery, the difficulties of vaginal surgery can be countered and an abdominal hysterectomy can be avoided.

There can be various modes of laparoscopic assistance for adnexal management. Any uncertainty about the condition of the adnexa or suspicion of adhesions might compromise safety of performing vaginal hysterectomy. In such cases a preliminary diagnostic laparoscopy would clarify whether or not it is safe to perform vaginal hysterectomy with oophorectomy. This would be a diagnostic contribution of laparoscopy to planned vaginal oophorectomy.

Any diagnosed adhesions may be severed during the preliminary laparoscopy allowing vaginal oophorectomy, or the adnexa may be freed or removed laparoscopically. This would then convert a seemingly impossible vaginal hysterectomy possible with minor increase in morbidity. This would be called a laparoscopic assisted vaginal hysterectomy.

The need for laparoscopic assistance during vaginal hysterectomy arises when the infundibulopelvic ligament is short and the ovaries are adherent to the side wall. It is also indicated in the previously mentioned contraindications for vaginal hysterectomy. In traditional abdominal or vaginal hysterectomy, endometriotic implants on the side wall, pelvic floor, bowel and bladder may be missed. Laparoscopic inspection would give a magnified view and the implants can be completely removed or ablated before hysterectomy. Ovarian endometriomas and Stage IV disease can be managed well laparoscopically in expert hands. Presence of any mass with restricted or no mobility, suspicion of malignancy, high risk patient, a large adnexal mass >10 cm, non-availability of frozen section and lack of experience would warrant laparoscopic assistance. Laparoscopy would help in assessing the nature of the mass, rest of the pelvis /abdomen, release any adhesions and remove the adnexa. The vaginal route should be abandoned when there is suspicion of malignancy, adhesiolysis is risky, there is uncontrollable bleeding or the possibility of incomplete removal.

Prerequisites in the management of adnexal masses should include clinical examination (assess mobility), imaging (to look for features suspicious of malignancy), CA-125 levels, preoperative counseling, consent for frozen section, consent for laparoscopy or laparotomy with due counseling.

Advantages of Laparoscopic Management

1. Avoids an abdominal incision and its attendant morbidity.
2. Offers a good visual inspection of the pelvis.
3. Confirms the benign nature of any adnexal mass.
4. Allows examination of the contralateral ovary.
5. Easier adnexectomy.
6. Adhesiolysis made possible.
7. Shorter hospital stay and earlier recovery than abdominal hysterectomy.

Techniques of Laparoscopic Adnexectomy

The patient is in low lithotomy position. Pneumoperitoneum is created. Three or four port sites can be used: one intraumbilical, two lower quadrant and suprapubic. With steep Trendelenburg position, a good deep view of the pelvis is obtained. The abdominal cavity can be carefully examined under magnification and the nature of abnormality assessed. Any adhesions can be released to aid better visualization or adnexal removal.

The round ligament is coagulated and cut. Its division helps to improve mobility and aids vaginal surgery. For adnexal removal, the tube and the ovary are held and lifted away from the pelvic wall thus moving safely away from the ureter. The infundibulopelvic ligament can be incised in three ways. These include bipolar coagulation and cutting; pretied ligature placement either extracorporeal or intracorporeal and automatic stapling devices. Good visualization by laparoscopy helps to ensure complete removal of the ovary and lesser chances of ovarian remnant syndrome (Figs 44.1 to 44.3). Figures 44.4 to 44.7 depict the same procedure in an ovarian cyst. The cyst is aspirated before coagulating the infundibular pelvic ligaments.

After management of adnexa rest of the hysterectomy is completed vaginally and the vault is closed, the abdomen can be re-inflated and the operative site

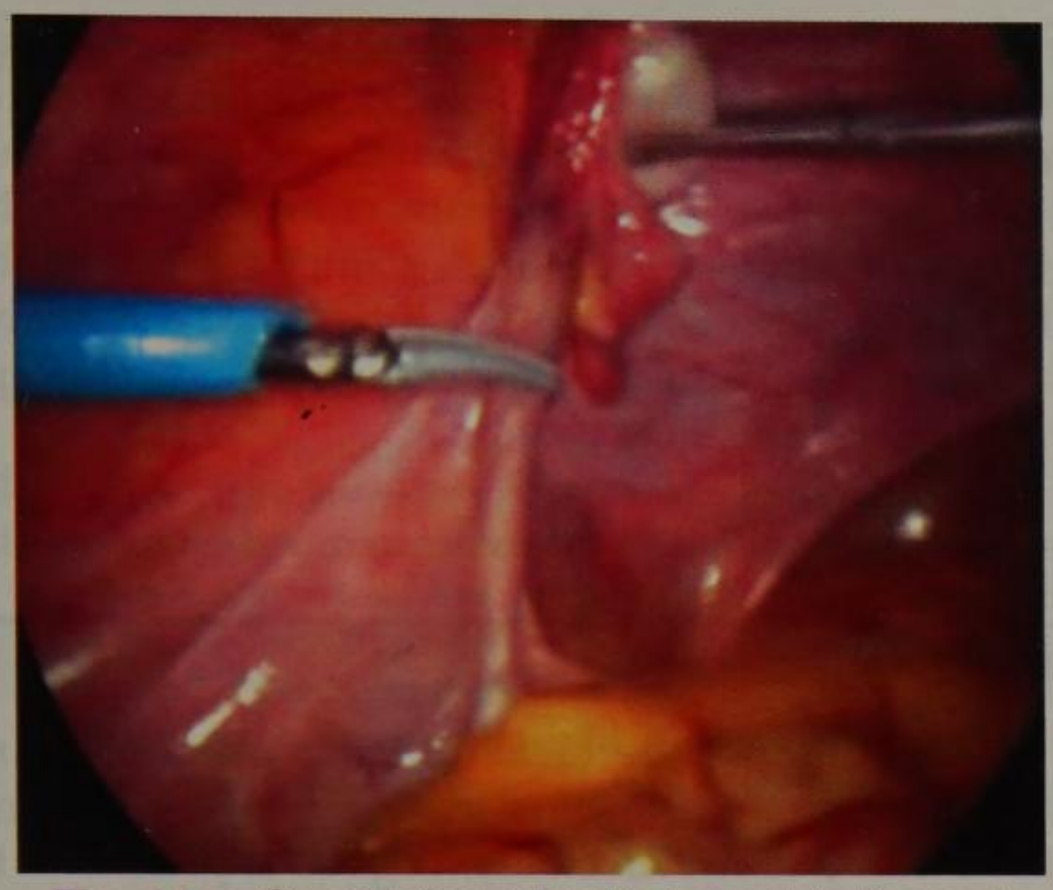

Fig. 44.1: Coagulating infundibular pelvic ligament

Fig. 44.2: Coagulation complete

Fig. 44.3: Cutting coagulated infundibular pelvic ligament

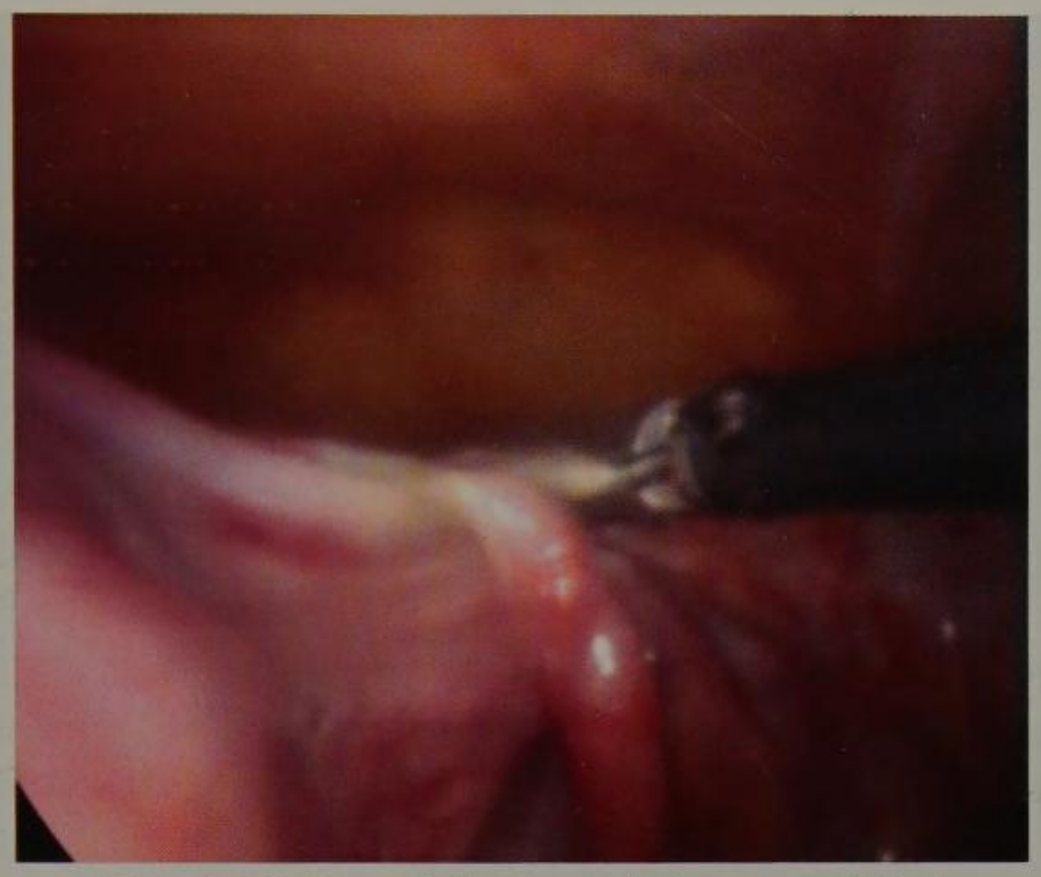

Fig. 44.4: Round ligament being coagulated

Fig. 44.5: Infundibular pelvic ligament held with bipolar forceps. Ovarian cyst being aspirated

Fig. 44.6: Infundibular pelvic ligament grasped, aspiration of cyst

Fig. 44.7: Ovarian cyst aspiration before coagulating infundibular pelvic ligament

inspected for any bleeding. Haemostasis can be ensured with bipolar cautery, staples or sutures.

Laparoscopy has its advantages as in ensuring accurate hemostasis, lesser hematoma formation, lesser blood transfusion, lesser postoperative infection and reduced recovery time.

The disadvantages of laparoscopic approach compared to vaginal approach are:

1. More invasive.
2. Added risks of trocar entry in the form of bowel, vessel and bladder injury.
3. More time consuming.
4. Increased cost of surgery.
5. Greater effort at debulking.
6. More spillage.
7. Lesser tissue for histopathology.
8. Difficult specimen retrieval, may sometimes require colpotomy (in cases where hysterectomy is not combined with oophorectomy).

VAGINAL ENDOSCOPIC OOPHORECTOMY

This is a newer approach of managing the adnexa during vaginal hysterectomy. Vaginal hysterectomy with oophorectomy is preferred to laparoscopy wherever possible. By making use of the endoscope vaginally, one can achieve the benefits of both vaginal route and the visualization of laparoscopy. This has been proposed as a safe and easy alternative to LAVH in the absence of pelvic adhesions.

After a standard vaginal hystererectomy, a retractor is used to achieve good visualization of the adnexa. A zero degree 10 mm panoramic view diagnostic telescope is introduced through the vagina to give good view of the ovaries. The ovary is gently held and pulled with a sponge holder into the operative field and over the midline and the mesovarium is clamped avoiding the tube. The oophorectomy can be accomplished endoscopic stapler, bipolar coagulation and cutting / tripolar forceps or endoloop with Sheth clamp.[10, 6]

Thus, the risks associated with the insertion of the Veress needle and blind trocar are avoided by this route.

CONCLUSIONS

It is important to be clear that no outcomes are significantly worse for vaginal hysterectomy than for any other method of hysterectomy; vaginal is preferable to abdominal hysterectomy where possible. No evidence supports the use of laparoscopic hysterectomy rather than vaginal hysterectomy if the latter can be done safely. The advantages of laproscopy have been highlighted and should be judiciously used. Laparoscopic route has clear advantages over the abdominal route and expertise in vaginal surgery is not widespread. In such situations instead of choosing the abdominal route, using laparoscopic assistance and completing the rest of the surgery vaginally would be a good compromise to still be minimally invasive.

Key Points

1. The various routes of adnexal removal in vaginal hysterectomy are vaginal oophorectomy, laparoscopic adnexectomy and vaginal laparoscopy.
2. Laparoscopic adnexectomy during vaginal surgery may be required in certain conditions such as poor access to ovaries, previous surgeries, pelvic adhesions, endometriosis, large uterine size, etc.
3. Although an expert vaginal surgeon may remove the ovaries even in difficult cases one must not hesitate to use laparoscopy in interests of the patient.
4. Prerequisites in the management of adnexal masses should include clinical examination, imaging, CA-125 levels, preoperative counseling, consent for frozen section and consent for laparotomy.
5. Advantages of laparoscopic management are—it offers a good visual inspection of the pelvis, confirms the benign nature of any adenexal mass, allows examinaiton of the contralateral ovary, easier adnexectomy, adhesiolysis and shorter hospital stay.
6. Techniques of both laparoscopic and vaginal removal of ovaries described.

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Section VIII

Genital Fistulae, Rectal Prolapse and Stress Urinary Incontinence

45

Vesicovaginal Fistula

JB Sharma

INTRODUCTION

Vesicovaginal fistula (VVF) is an abnormal communication between the bladder and the vagina which allows continuous involuntary leakage of urine per vaginum. It is usually due to obstetric causes in developing countries, but can be due to gynaecological surgeries or after radiation therapy.

Aetiology

The most important cause of VVF in the developing world is prolonged obstructed labour[1]. In Africa it is usually due to lack of safe hospital delivery due to poor infrastructure, long distance to reach care, poor transport network, lack of money and myths that delivery should be at home.[2,3] Other important causes of VVF are caesarean section, injury from different surgeries, gynaecological malignancies, radiation therapy, sexual abuse, injuries and infection.[4,5] Contracted pelvis and malnutrition play a role by causing obstructed labour.[4] Harmful traditional practices like gishiri cutting in Northern Nigeria in which a series of random cuts are made through the anterior vagina involving urethra, bladder neck for many gynaecological conditions can also cause VVF.[6]

Prevalence

Exact prevalence is not known and is under reported as many women never come forward for treatment. In rural Ethiopia, there are 2.2 fistula patients per 1000 women in the reproductive age group (15-49 years).[7] In Niger and Kenya 1 per 1000 deliveries are complicated by obstetric fistula.[2] Exact prevalence in India is not known, however it is lower than Africa, but is much more than the developed world.

Symptomatology

A typical history is of prolonged and obstructed labour of many days at home supervised by family members or untrained persons followed by delivery of a dead baby and urinary or faecal incontinence. Many women die of obstructed labour others have near death experience followed by fistula formation. They are usually deserted by their husbands and ostracized by the society due to continuous urinary incontinence and bad urinary smell. They present with continuous urinary incontinence with or without faecal incontinence. They often have amenorrhoea, infertility, vaginal atrophy and are very depressed.

Examination

Woman is a typically short statured, although is not always smelling of urine. On local examination, there is a smell of urine, sordies (furuncles all over external genitalia due to irritation of urine). Using Sim's speculum in Sim's left lateral position or in dorsal position, urine can be seen coming out through a fistulous opening in the vagina. The size, shape and number of fistulas are noted carefully. Examination under anaesthesia and dye testing should be performed and cystoscopy should be done to confirm the diagnosis, size, shape, number and exact location of the fistula and position of fistuala in relation to ureters.

Treatment

If a fistula is detected immediately after delivery or as a prophylaxis in obstructive labour, Foley's catheter is left continuously for 3-4 weeks as upto 60% fistulas may heal with time without surgery by continuous urinary drainage as the margins of the fistula come together and

there is no pressure on the fistula side.[7-9] However, most of fistula need surgical repair. Every fistula is unique and needs individual care. They should be repaired by experts surgeons (gynaecologists and urologists with interest and training in fistula surgery) who have performed fistula surgery before for optimum outcome as best results are obtained with first surgery. The route of operation is usually vaginal, but can be abdominal for high fistula in which case either transabdominal or transvesical approach can be used as ureters are nearby.[10-12]

Principles of Fistula Repair

They are as follows:[7]

1. Good mobilization of bladder from vaginal wall
2. Identification of ureters.
3. Adequate closure of bladder wall with appropriate suture.
4. Testing for integrity and closure by instilling dye into the bladder.
5. Liberal use of interposition of graft material between bladder and vagina for better results.
6. Closure of vaginal wall with appropriate suture.

Technique

The patient is put in exaggerated lithotomy position for adequate exposure of operation field. In case of narrow and tight vagina, Schuchardt's incision is given for relaxation of vagina. Traditionally flap splitting method of repair is used in which bladder and vaginal mucosa are repaired separately after adequate dissection. The fistula is identified and its location made out (Fig. 45.1). Ureters are identified.[7,10,12] Ureters may be cannulated if the fistula is very close to them. A circular incision is made all around the fistula. An inflated bulb of Foley's catheter may be used for better visualization of fistula margins (Figs 45.1 and 45.2). Bladder is dissected off the vagina adequately without any tension (Fig. 45.2). The bladder is closed using polyglycolic acid (Vicryl) 2-0 sutures on round body needle in two layers with inner full thickness continuous mucosal inverting layer (Figs 45.3 to 45.6) and outer interrupted seromuscular Lembert layer and an air water tight closure is ensured (Fig. 45.7 and 45.8). Dye testing may be done to confirm the complete closure.[13] A Martius or bulbocavernosus graft my be brought to cover the defect in cases of thin bladder for better healing as the graft has its own blood supply.[14,15] In cases of abdominal closure of fistula, omental, rectus abdominis muscle flap or peritoneal flap can be used for interposition between bladder and vagina.[16] In cases of deficit bladder wall or proximity of ureters to the fistula, first layer can be brought from the vagina using a mobilized flap.[17] Even foreign materials like duramater, oxidized cellulose (surgicel) has been used as an interposition material.[18] Vaginal mucosa is then closed using 2–0 vicryl interrupted sutures usually at right angle to the bladder sutures (Figs 45.9 and 45.10).

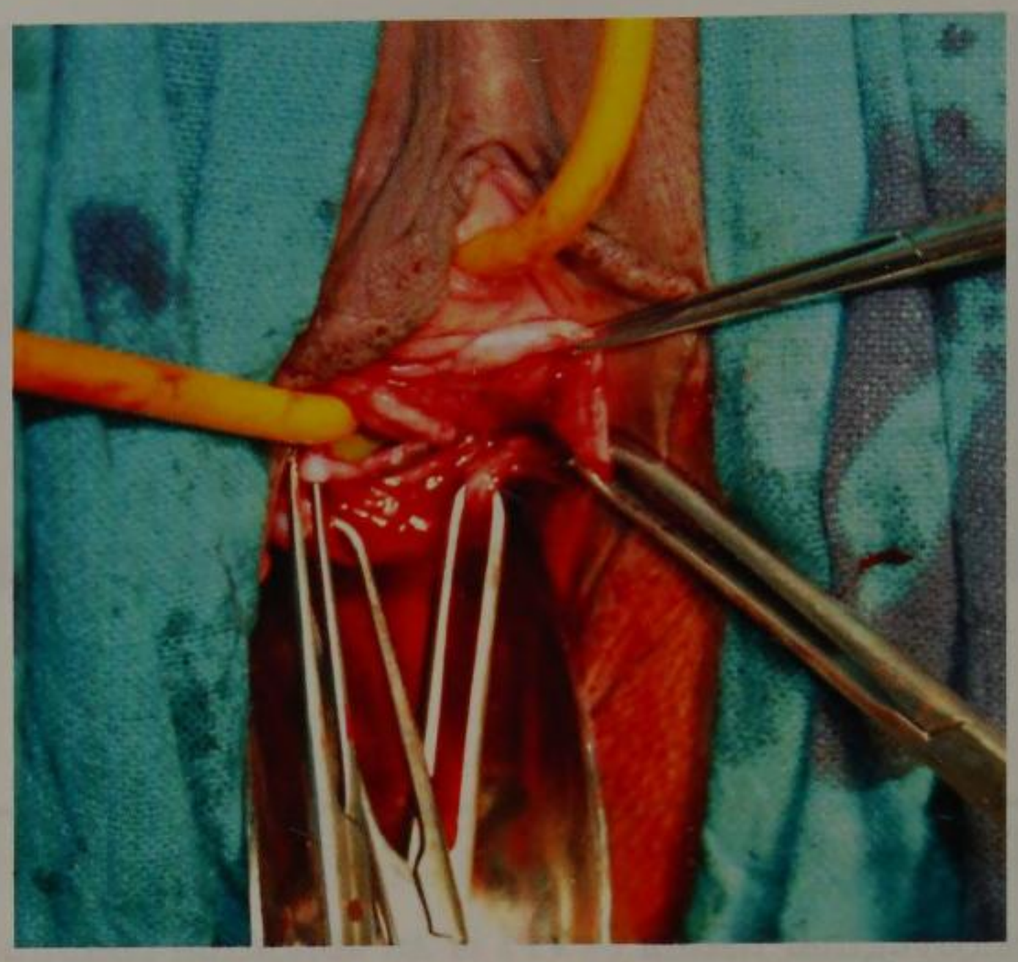

Fig. 45.1: Showing incision around a large VVF with Foley's catheter inserted in the fistula

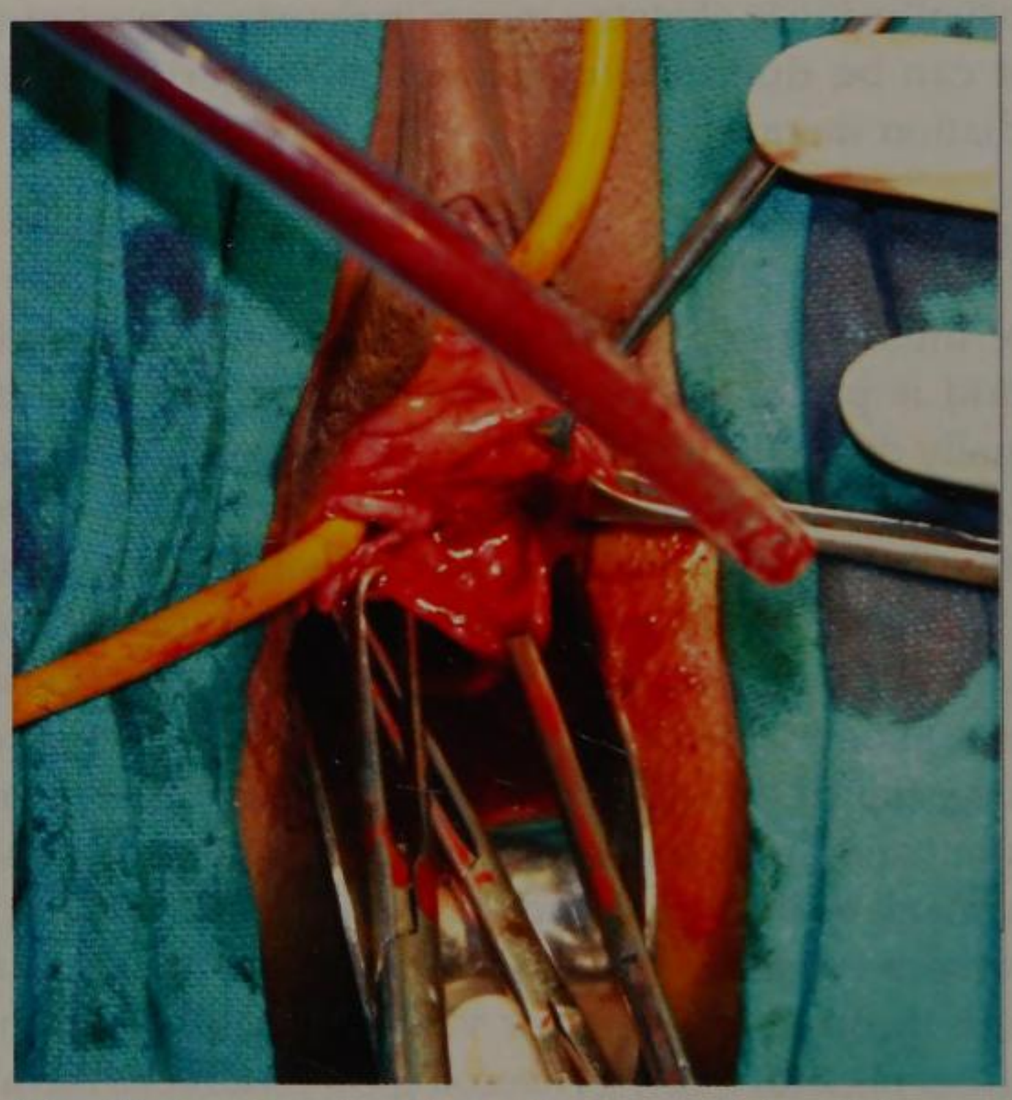

Fig. 45.2: Showing dissection around the VVF with Foley's catheter inserted in the fistula

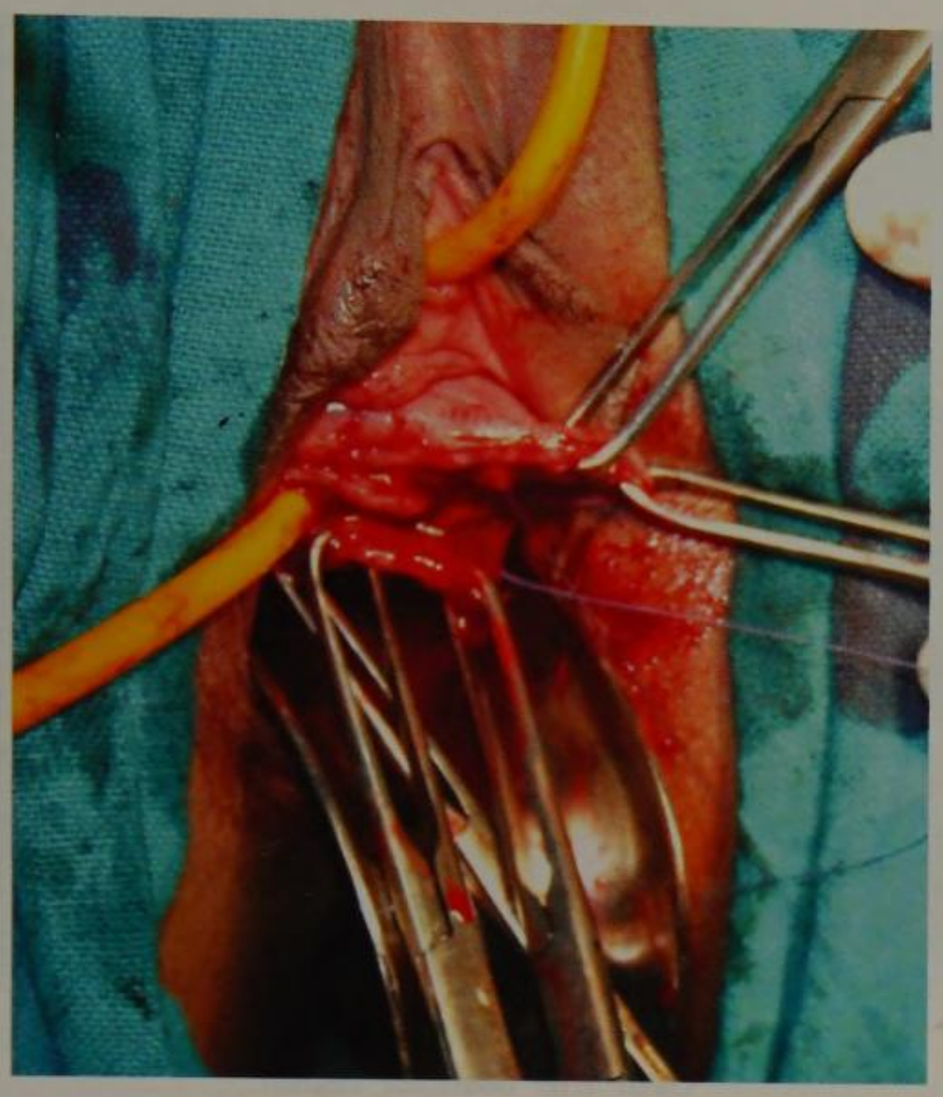

Fig. 45.3: Showing closure of first layer of bladder with 2-0 vicryl sutures

Fig. 45.5: Showing closure of first layer of bladder from the other side of fistula

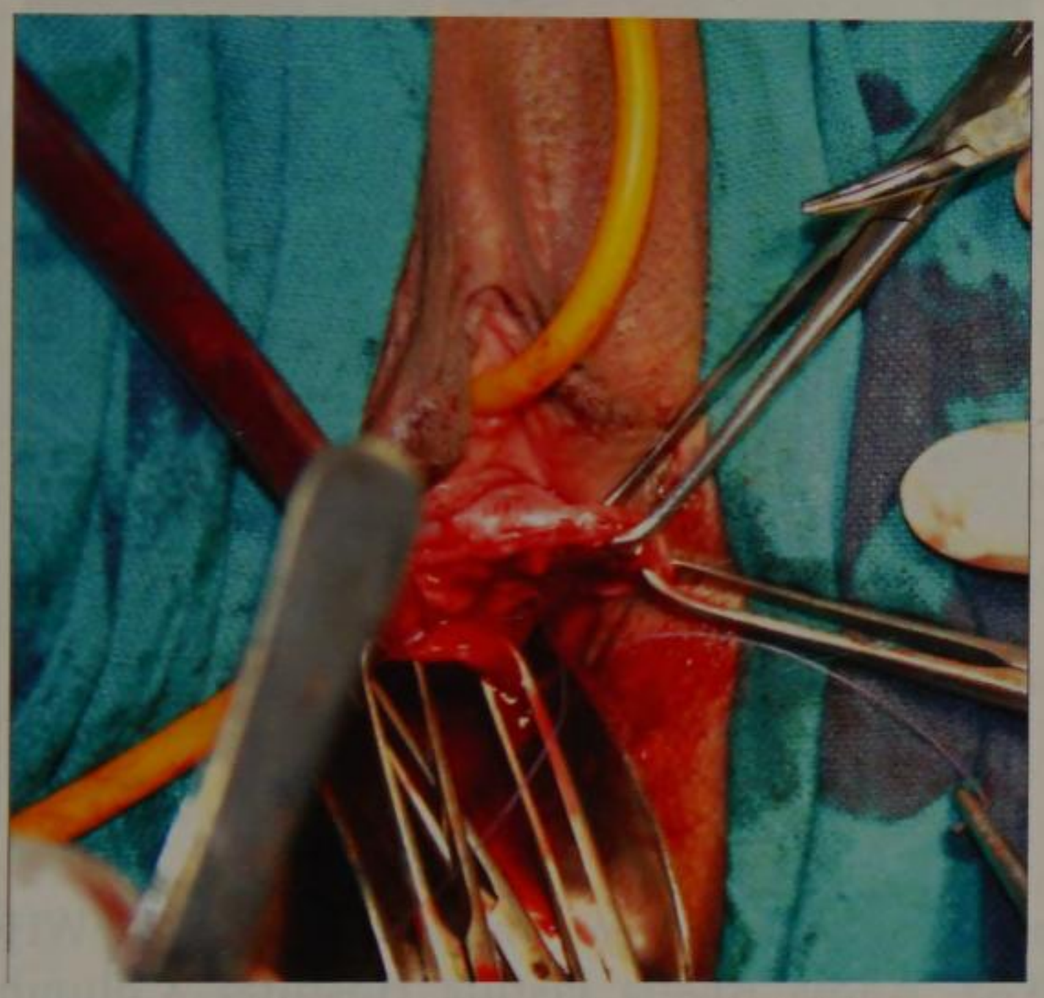

Fig. 45.4: Showing further closure of first layer of bladder with 2-0 vicryl sutures

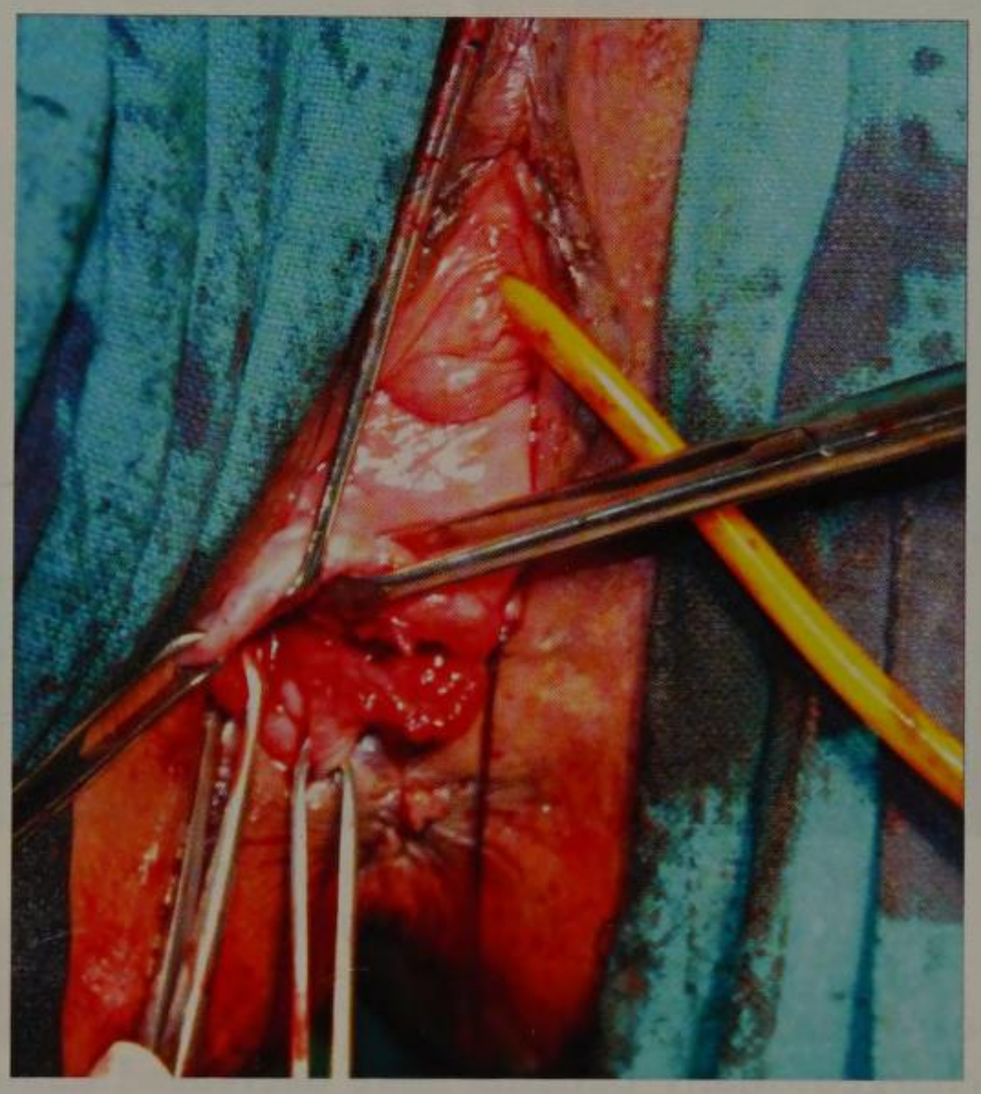

Fig. 45.6: Showing completion of closure of first layer of bladder

For vault fistulas after hysterectormy, Latzko's operation is performed in which partial colpocleisis is performed at the vault after closure of bladder.

Complete decompression of the bladder in post operative period is very important for which a Foley's catheter 16Fr to 18Fr is left for 3-4 weeks. Adequate hydration by intravenous fluids initially and oral fluids later is important for good urinary output. Catheter must not be manipulated to avoid damage to the stitch line and patency of the catheter must be ensured. Antibiotics and analgesics are given as per protocol of the hospital and depending upon the culture sensitivity report. Patient is kept admitted for 2-3 weeks. Catheter is removed after 3-4 weeks depending upon the individual

Fig. 45.7: Showing closure of second layer of bladder with vicryl 2-0 sutures

Fig. 45.9: Showing closure of vaginal mucosa over the bladder repair

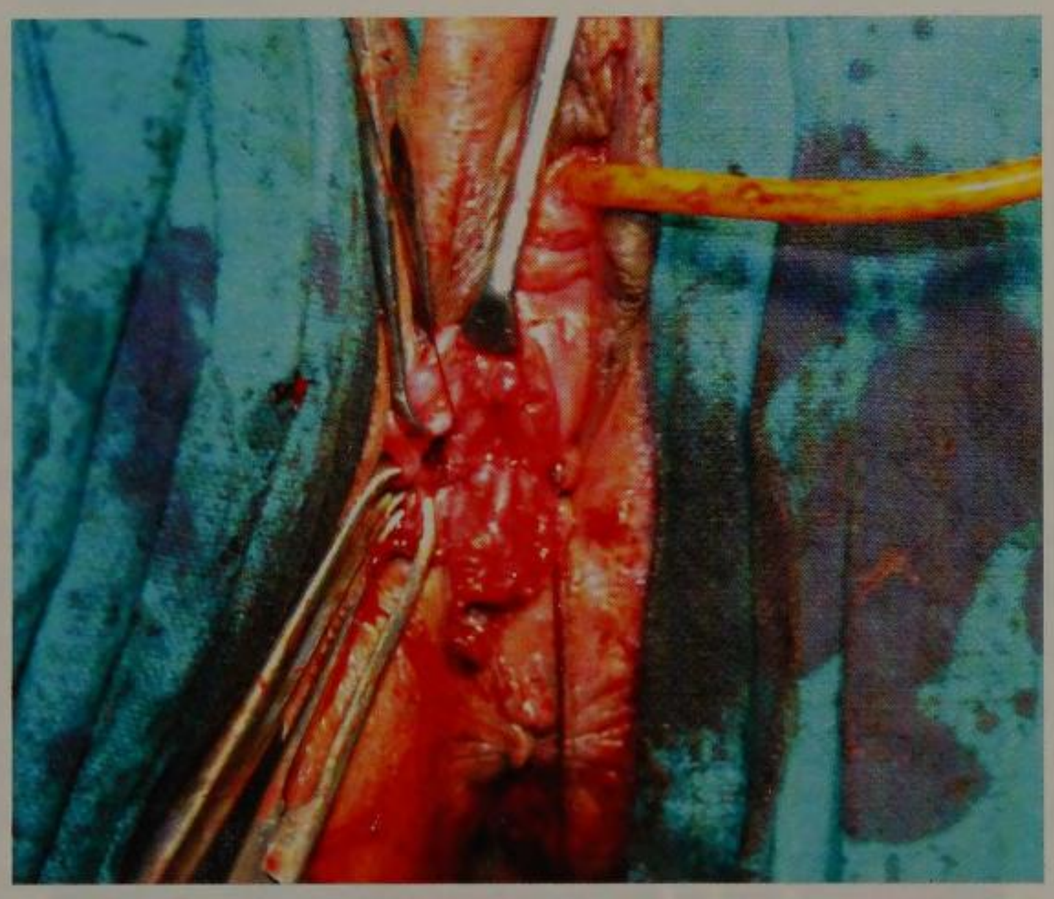

Fig. 45.8: Showing completion of closure of second layer of bladder

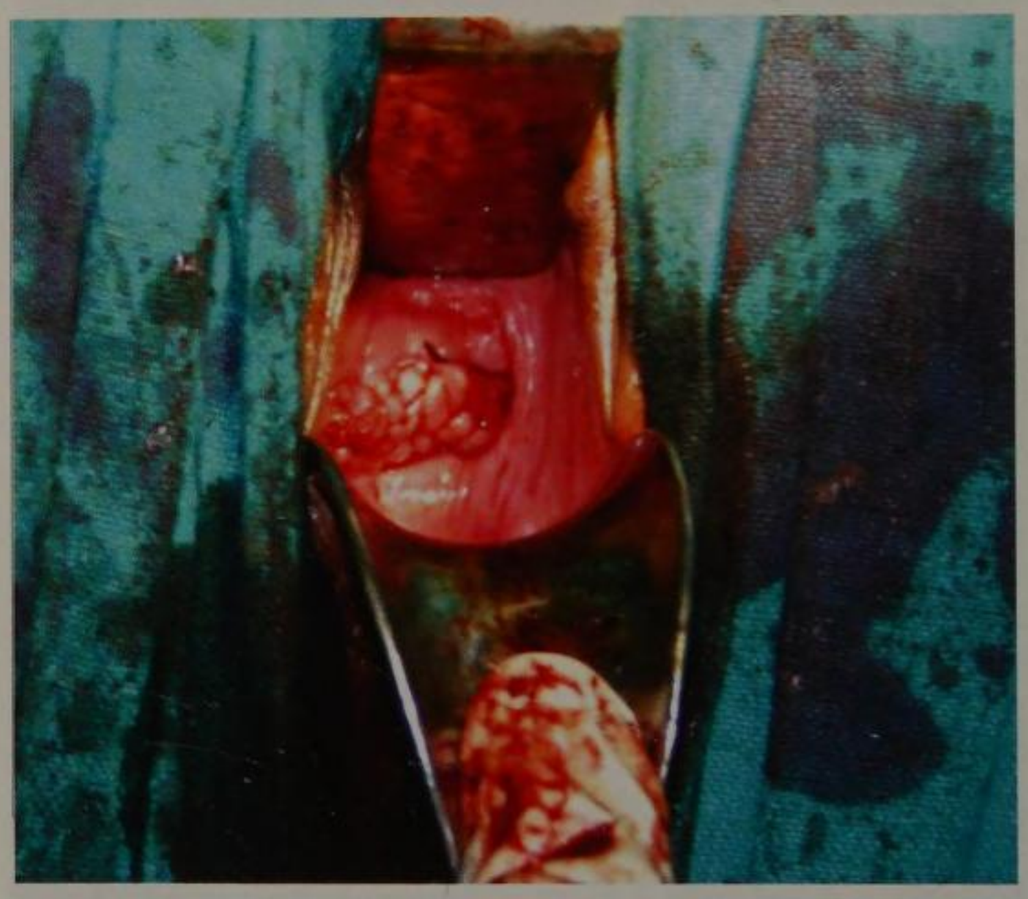

Fig. 45.10: Showing completion of closure of vaginal mucosa over the bladder repair

case. When she is able to pass urine, she can be discharged. Many patients have decreased bladder capacity or may develop urge or stress incontinence after fistula repair and may need tolterodene or oxybutynin (for urge incontinence) or duloxetine (for stress incontinence). With good repair a success of 85 to 90 % can be achieved.

CONCLUSIONS

The VVF is an important cause of severe maternal morbidity. Ideally they should be prevented by optimizing obstetric care. Various agencies like WHO, FIGO, Addis Ababa Fistula Hospital, Columbia University's Averting Maternal Deaths and Disability Programme (AMDD), UNFPA have come together in their campaign to end fistula.[19] They have come up with obstetric fistula working group-meeting report: training for fistula management for the better training of surgeons dealing with these women.[20] However, VVFs do happen and need proper diagnosis and adequate and appropriate surgical treatment by expert surgeons to help these helpless women.

Key Points

1. Vesicovaginal fistula is encountered still in developing countries mainly due to obstructed labour.
2. Preoperative evaluation should be thorough in order to choose right surgical technique.
3. Flap method is most commonly practised method for repair of VVF.
4. Interposition of graft, mesh improves surgical results.
5. Postoperative care is an imperative part of management.

Acknowledgement

I am thankful to Dr. KK Roy for allowing me to take photographs of fistula repair from his patient which we operated together.

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Rectovaginal Fistulae

Sanjay Gupta

INTRODUCTION

Rectovaginal fistula (RVF) is an epithelium lined communication between rectum and vagina. Though rectum is most commonly involved, communication may also exist between vagina and other parts of gut such as small bowel, colon and anal canal.

RVF not only causes contamination of vagina by fecal matter, with attendant physical symptoms, it also leads to significant social embarrassment and loss of dignity for the unfortunate individual who suffers from it.

Etiology

RVF is a condition with varied etiology. In a female neonate, imperforate anus is most commonly associated with rectovestibular fistula. In less than 1% of patients there is a true rectovaginal fistula, where the fistula opens proximal to the hymenal ring.[1]

A case of isolated H type fistula has been described in the literature. A 2-month-old child presented with labial abscess. Dye study of the rectum showed an H type of fistula, which closed spontaneously following drainage of the abscess.[2] Another rare cause of rectovaginal fistula is complete duplication of colon with one colon opening in the normal rectum and anus, while the second colon communicates with vagina.[3]

Trauma is the commonest cause of RVF in the developing world. This trauma is usually sustained at the time of child birth. It may be due to prolonged obstructed labour with widespread ischemic injury to pelvic tissues and development of both vesicovaginal fistula (VVF) and RVF. Trauma due to application of forceps, as well as fourth degree perineal tear, may result in formation of RVF. The reported incidence of RVF following obstetric injury varies widely and is directly related to the quality of obstetric care available to the general population.[4, 5]

RVF has occurred following penetrating injury to the perineum or following forceful coitus. The latter injury is especially likely to occur in a patient with vaginal atresia with neovagina.[6, 7]

RVF has been reported following douching of vagina with strong alum solution, a practice followed in certain parts of Africa, with the supposed aim of enhancing the pleasure of coitus.[8] Injuries to rectum and vagina, sustained during surgical procedures such as difficult hysterectomy, excision of tumors located on the anterior wall of rectum and stapled hemorrhoidectomy have all resulted in development of RVF.[9-11] Use of non-absorbable sutures for reconstructive posterior vaginal wall surgery as well as erosion of non-absorbable mesh following abdominal sacrocolpopexy has been associated with the development of RVF.[12, 13]

From the developed world, bowel diseases like Crohn's disease, ulcerative colitis and diverticulitis are increasingly being reported as predisposing causes for enterovaginal/colovaginal fistula. The chance of fistula increases if the patient has a scar in the vaginal vault from a previous surgical procedure like hysterectomy.[14-17] Perianal abscess may burst into vestibule and predispose to the development of ano-vestibular fistula.

Malignancy in the rectovaginal region can cause RVF by infiltration of rectum and vagina with subsequent sloughing of the malignant tissue. Radiotherapy or surgical treatment of these malignancies can also precipitate formation of RVF. Radiotherapy causes widespread ischemic damage to pelvic tissues and can lead to delayed breakdown of rectovaginal septum. These fistulas are notoriously intractable and difficult to treat.

Symptoms of RVF

The physical symptoms of RVF are varied and depend upon the size of fistula, consistency and quantity of fecal matter, presence of infection and inflammation and underlying etiology of RVF.

At one end of the spectrum, a small RVF may be practically asymptomatic with occasional passage of flatus or stool, while in the most severe case the patient may be completely incontinent, with uncontrolled passage of liquid stool, with inflammation and ulceration of vagina and perineal skin.

Apart from these physical symptoms, the patient suffers from mental agony, has difficulty in personal relations and may be shunned by society.

Clinical Examination

A detailed history should be taken to confirm that the fecal soiling is occurring through vagina and not through anus. Onset of symptoms following childbirth suggest obstetric trauma as the precipitating cause. Prior symptoms of bowel disease like diarrhea, blood and mucus in stool and features suggesting bowel obstruction may point to Crohn's disease, ulcerative colitis, diverticulitis or rectal malignancy as the cause of RVF.

A proper history defines the symptoms of the patient, their severity and the degree of distress caused by them. This helps in defining the goals of therapy.

The physical examination begins with inspection of perineum. There may be discharge of pus or fecal matter from vagina. The perineal skin may be excoriated. Alternatively, in a tiny RVF, inspection of perineum may be essentially normal. Attention may then be directed to perianal region. Presence of multiple sinuses may suggest tuberculosis or Crohn's disease.

Speculum examination of vagina may reveal vaginitis. The opening of RVF may be visible and its relation to hymenal ring should be noted, fistulas distal to hymenal ring being vestibular fistulas. Palpation may reveal areas of tenderness and induration in the vault or posterior vaginal wall suggesting presence of infection. Any features suggesting malignancy should also be noted.

Digital examination of anal canal is then done to assess anal sphincter integrity and tone. Digital rectal examination is done to locate the opening of RVF in rectum, its size as well as the quality of surrounding tissue, whether supple or fibrous. Rectal malignancy, if present, is detected. A bimanual examination of rectovaginal septum, with one finger in vagina and another in rectum is especially helpful for thorough assessment. Anoscopy and proctoscopy complete the rectal evaluation.[18] At times, though the history is suggestive, examination does not reveal the site of a small RVF. In such instance, a tampon test may be performed by instilling methylene blue in the rectum, with a tampon in vagina, to confirm the location of RVF.[19]

Examination Under Anesthesia (EUA)

Examination under anesthesia (EUA) may be done next, if office examination is unsatisfactory, or the fistula is not identified. This is especially likely to happen if there is significant tenderness. EUA not only permits better exposure, but allows probing of suspected fistula sites, as well as drainage of any abscess present. In case the fistula is difficult to identify, a non-absorbable thread can be passed through the RVF, brought out through anus and vagina, and tied loosely on the perineum. This suture (marking seton) helps in the easy identification of RVF during definitive surgery.

If orifice on only one side is identified, it may be cannulated and injected with hydrogen peroxide solution, while the other side is identified by escaping gas bubbles. If neither orifice is identifiable, a vaginal speculum examination under water is done while rectum is insufflated with air through a Foley catheter.

Contrast Radiography and Endoscopy

At the conclusion of EUA one of the three outcomes are possible.

- A simple RVF may be identified, in which case planning for treatment may begin.
- If a complex RVF is identified, further evaluation is necessary to identify the underlying cause. In suspected Crohn's disease, small bowel series and barium enema or colonoscopy may be necessary. If malignancy is suspected, biopsies should be taken and extent of malignancy should be defined using CT scan or MRI.
- Finally, if RVF is still not identified following EUA, a vaginogram followed by barium enema, if necessary, may delineate the RVF. It is to be noted that vaginogram should precede barium enema, as the dye clears faster from vagina, and there is no issue of residual dye misleading the interpretation of a subsequent barium enema study.

Issue of Continence

All patients with RVF, especially those following obstetric trauma, should have a thorough evaluation for anal incontinence. The incidence of occult sphincter injury following apparently normal delivery is as high as 13%. The incidence is higher following forceps delivery.[20] Assessment includes inspection of perianal region for scars, which may suggest previous perineal tears. Digital evaluation of anal canal is done for sphincter tone and presence of defects in anal sphincter. A more objective evaluation of anal anatomy and sphincter defects is done using endoanal ultrasound examination. Hitherto unidentified tract of coexistent RVF may also be shown by this examination. In case no anatomical defect is identified, neurological and functional evaluation of continence may be done using nerve conduction studies and anal manometry.[20]

Repair of RVF without management of associated anal incontinence will lead to poor outcome. In addition, presence of associated anal sphincter injury necessitates that the method chosen for RVF correction should permit repair of anal sphincter as well.

Classification of RVF

There are many ways of classifying RVF, based upon the size, location, cause and previous treatment history. However, there is no single universally accepted method of classification. This makes comparison between different series difficult. Depending upon the location, RVF may be defined as ***low*** if the rectal opening is just above the dentate line and vaginal opening is at the level of fourchette. A ***high*** RVF has the vaginal opening close to cervix, while ***mid*** RVF is located in between these two types.

RVF may be classified as ***small*** if they are less than 2.5 cm in diameter and ***large*** if more than 2.5 cm in size.

A comprehensive classification, based on various prognostic factors, has been described. According to this classification a ***simple*** RVF with good prognosis is one which is small, low and due to trauma or infection. A ***complex*** fistula, with poorer prognosis, is large, high, caused by inflammatory bowel disease, irradiation or carcinoma or has multiple failed attempts at repair in the past, irrespective of location.[18]

Management of RVF

Principles of Management

The treatment of RVF depends upon its classification, etiology, previous attempts at repair and status of anal sphincter.

RVF repair should be attempted only when the local tissue is healthy and non-inflamed. Any pockets of pus should be drained. In case of RVF due to Crohn's disease or ulcerative colitis, appropriate medical therapy should be started and the disease controlled, before attempting repair. It should be ensured that there is no bowel obstruction distal to RVF. Usually a period of 3-6 months is required to achieve the desired local result, before repair is attempted. In case of complex RVF, a diverting colostomy may be created initially to achieve desired local result. The colostomy is retained to cover subsequent RVF repair, till it is well healed. Occasionally, creation of a colostomy by itself leads to closure of a small RVF. In case of malignant or post radiation RVF, repair may be considered impossible and a permanent diverting colostomy may be required.

Surgical Procedures

A variety of surgical procedures are available for repair of RVF. These include transvaginal, transanal, transperineal and transabdominal repairs; with or without tissue interposition. The choice depends on the surgeon's expertise, type of fistula, previous attempts at repair and whether or not sphincter defect is present. As discussed, the local tissues need to be healthy before any definitive surgical repair is undertaken. The surgery may be performed under regional or General anesthesia, with full mechanical and antibiotic bowel preparation.[5, 19]

The surgical options for RVF may be summarized as follows:[19]

1. Local repairs
   a. Transanal approach
      i. Advancement flap
      ii. Layered closure
   b. Vaginal approach
      i. Inversion of fistula
      ii. Layered closure
   c. Perineal approach
      i. Fistulotomy

ii. Perineoproctotomy and layered closure
iii. Sphincteroplasty
2. Abdominal procedure
   a. Low anterior resection
   b. Onlay patch anastomosis
   c. Coloanal anastomosis
   d. Abdominoperineal resection
   e. Diversion
3. Tissue transposition
   a. Omentum
   b. Gracilis
   c. Sartorius
   d. Gluteus maximus
   e. Bulbocavernosus

Transanal Approaches

Transanal approach is generally preferred by colorectal surgeons who are familiar with the area. This approach has advantage of direct access to rectal side of RVF, which many believe is the high pressure side of the fistula and needs secure closure. However, exposure is limited in comparison to transvaginal repair. Transanal repairs are further subdivided into linear advancement rectal flap (LARF), curvilinear advancement rectal flap (CARF) and advancement rectal sleeve (ARS) procedure.

Linear advancement rectal flap (LARF) is simple excision of fistula followed by layered closure of rectovaginal septum (Figs 46.1 and 46.2). It is possible only in simple RVF with good local tissues.

Curvilinear advancement rectal flap (CARF) is performed under general anesthesia with patient in jack knife position. After cleaning the rectum to remove any residue, rectal side of fistula is displayed by using suitable retractors and anal effacement stitches (Fig. 46.3). The

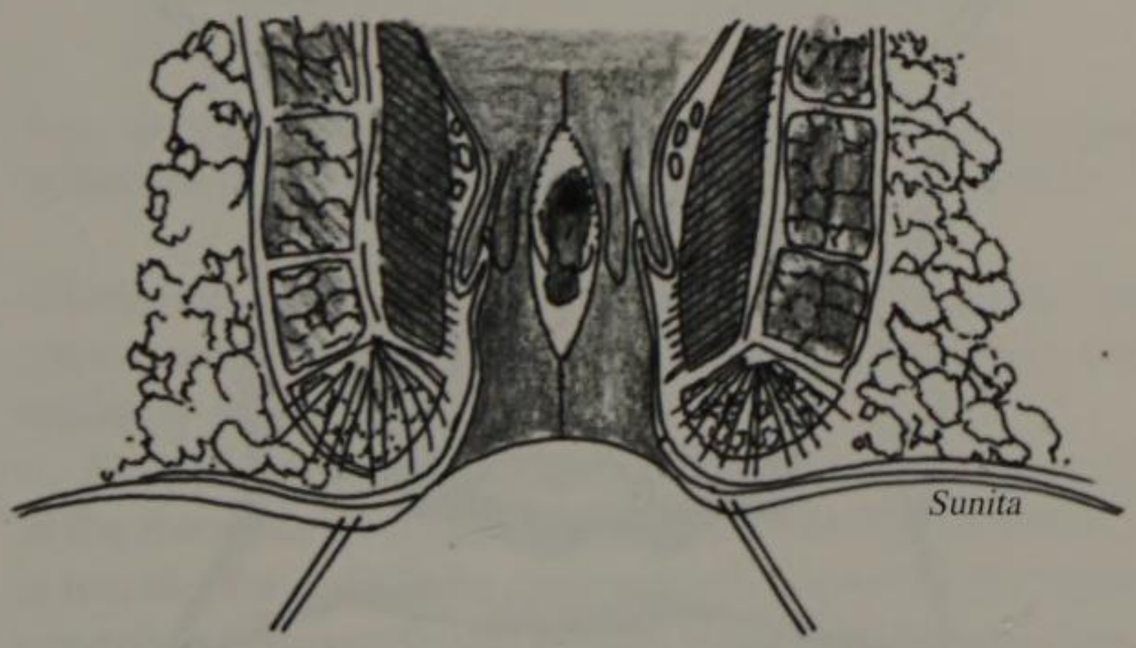

Fig. 46.1: Linear advancement rectal flap (LARF). Vertically oriented elliptical incision is given around the rectal opening of RVF and fistula dissected up to vagina

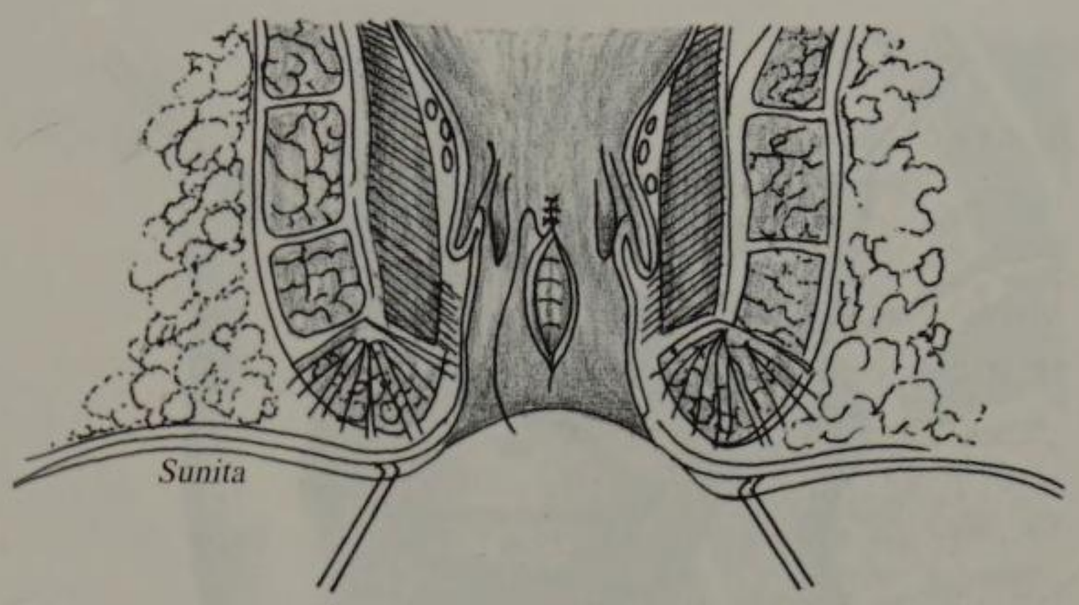

Fig. 46.2: Linear advancement rectal flap (LARF). Defect following fistulectomy is closed in layers

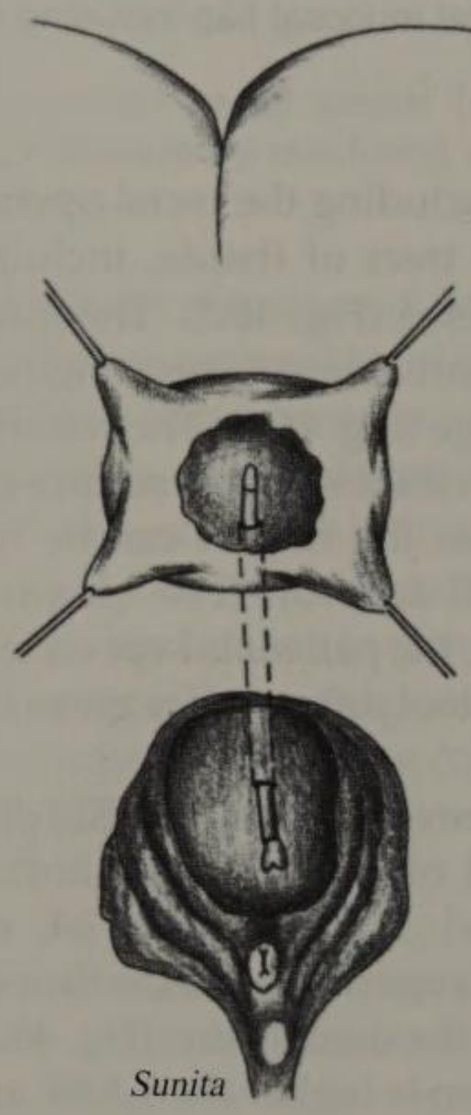

Fig. 46.3: Curvilinear advancement rectal flap (CARF). Exposure of RVF through rectum with patient in jack knife position

line of dissection is infiltrated with dilute adrenaline (1:200,000) solution. Electrocautery is used for dissection, to reduce bleeding further. The flap raised includes mucosa, submucosa and superficial muscle fibers. The dissection starts just above the dentate line in anal canal. A curvilinear flap is raised, including the rectal opening of fistula, with the base of flap base proximally (Fig. 46.4). Care is taken to keep the base broad to preserve the vascularity of the flap. Once a suitable flap is raised, the

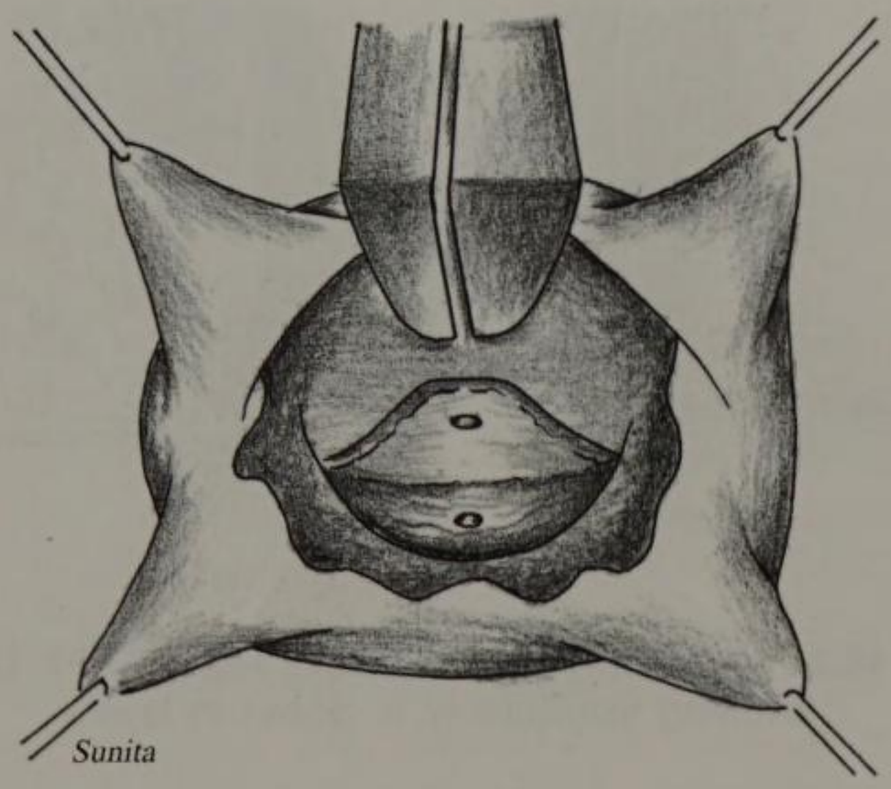

Fig. 46.4: Curvilinear advancement rectal flap (CARF). Raising of curvilinear rectal mucosal flap including the rectal opening of RVF

tip of the flap including the rectal opening of the fistula is excised. The tract of fistula, including the vaginal opening, is excised (Fig. 46.5). The tract is closed with interrupted absorbable sutures. Vaginal mucosa is left open for drainage (Fig. 46.6). The refashioned rectal flap is sutured back with absorbable sutures (Fig. 46.7). If there is any tension in the flap, it can be further dissected proximally till tension-free closure is achieved. Postoperatively, the patient is kept on intravenous fluids for a few days. Stool softeners are given to ensure passage of soft stools.

The rectal sleeve procedure (ARS) differs from CARF in that, instead of a flap on the anterior rectal wall, circumferential mobilization of rectal mucosa, submucosa and superficial muscle fibers is done, starting from just above the dentate line (Fig. 46.8). The proximal limit of dissection is higher than ARF and may go up to the level of peritoneal reflection (Fig. 46.9). After excising the fistula containing portion of the sleeve, rest of the procedure is similar to CARF (Fig. 46.10). The sleeve procedure is a more extensive procedure and is indicated for complex RVF. It has been successfully used in cases of RVF due to Crohn's disease.

The reported success following transanal procedures varies form 41% to 100%. Some surgeons have included anal sphincter repairs along with CARF or ARS.[5]

Transperineal Approaches

Transperineal approach is indicated in those women who have associated sphincter defect, or those who have previous failed attempts at transanal or transvaginal repair. In the latter group of patients, local anatomy is

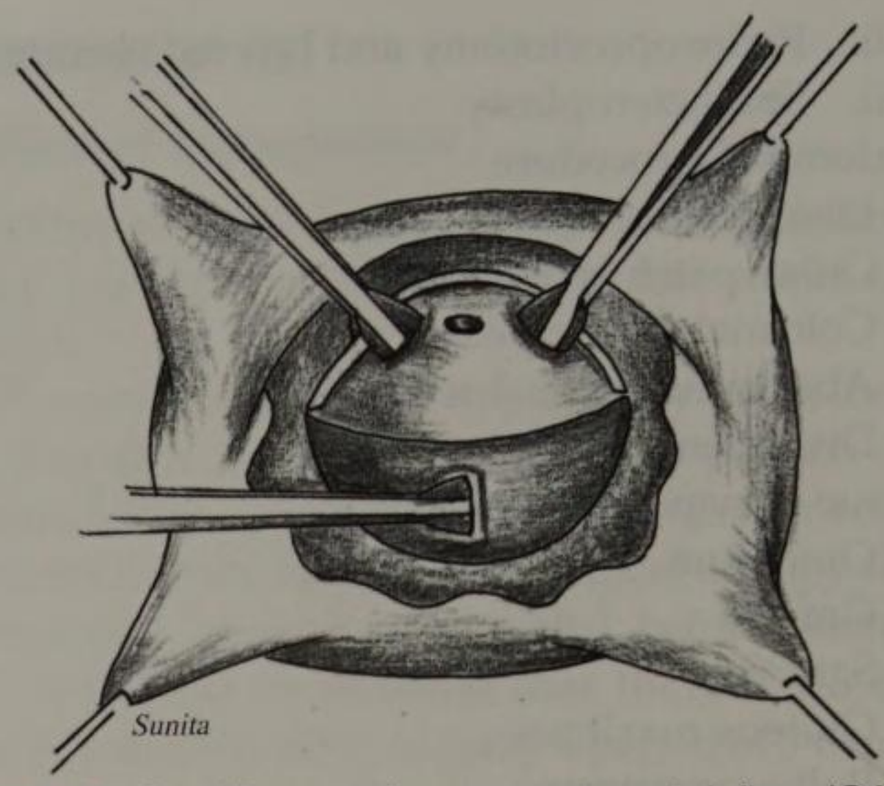

Fig. 46.5: Curvilinear advancement rectal flap (CARF). The fistula tract is excised

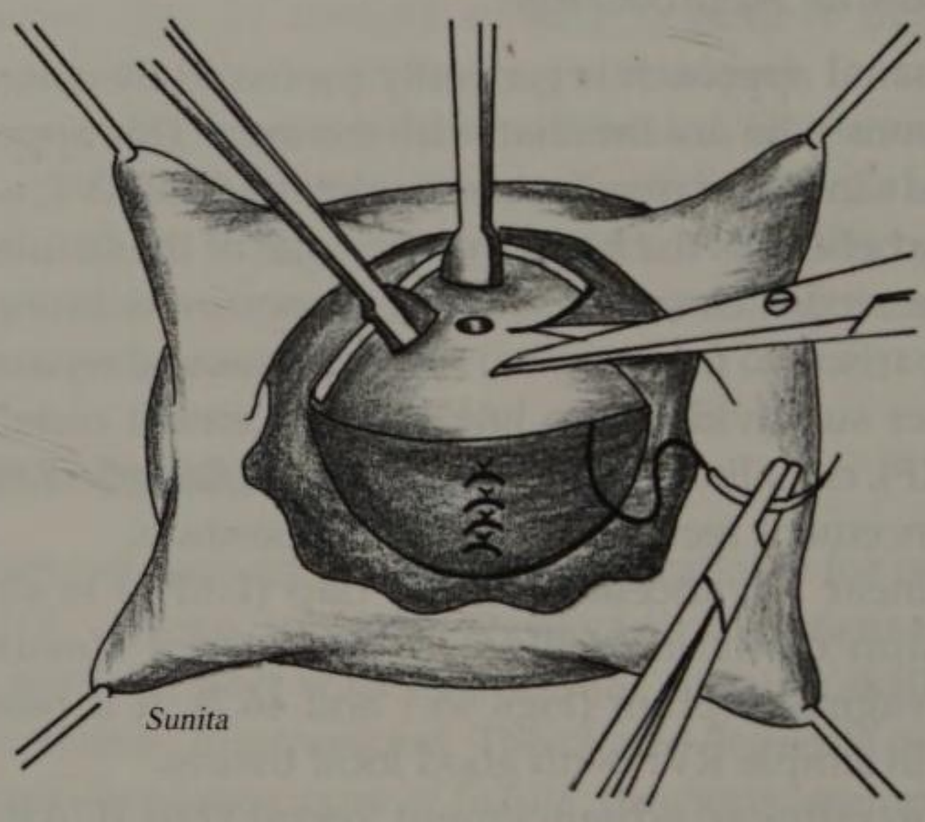

Fig. 46.6: Curvilinear advancement rectal flap (CARF). Rectovaginal septum is repaired, leaving the vaginal mucosa open

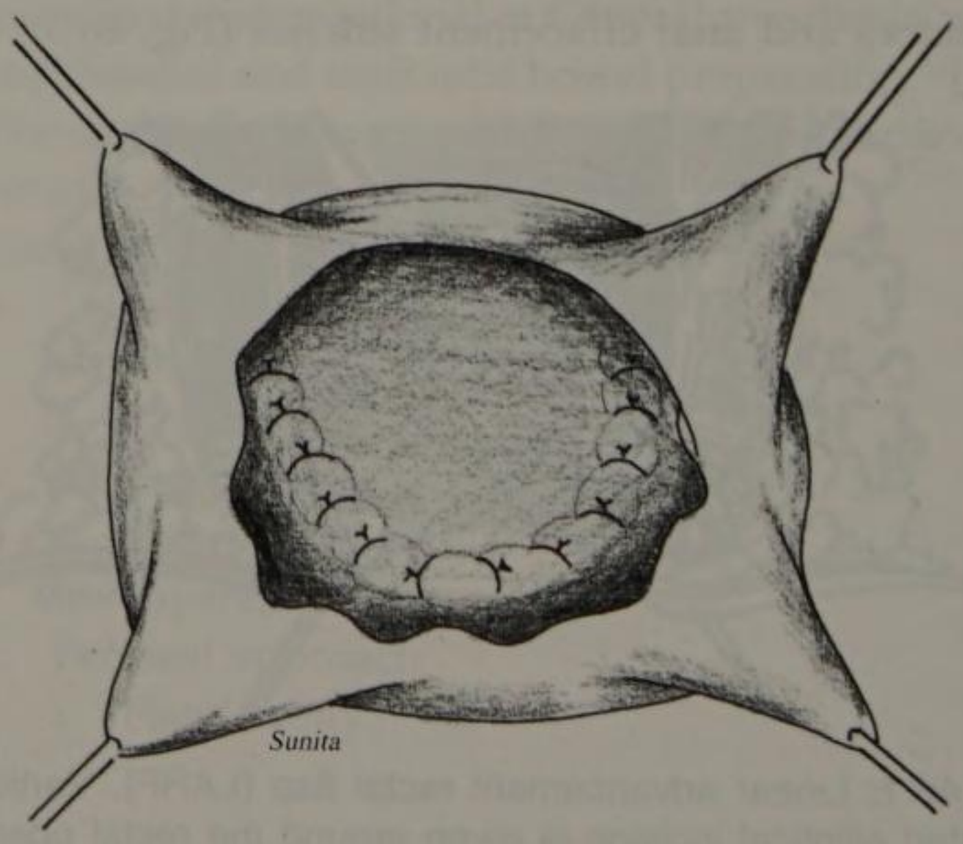

Fig. 46.7: Curvilinear advancement rectal flap (CARF). Rectal flap is resutured after exicising the diseased part

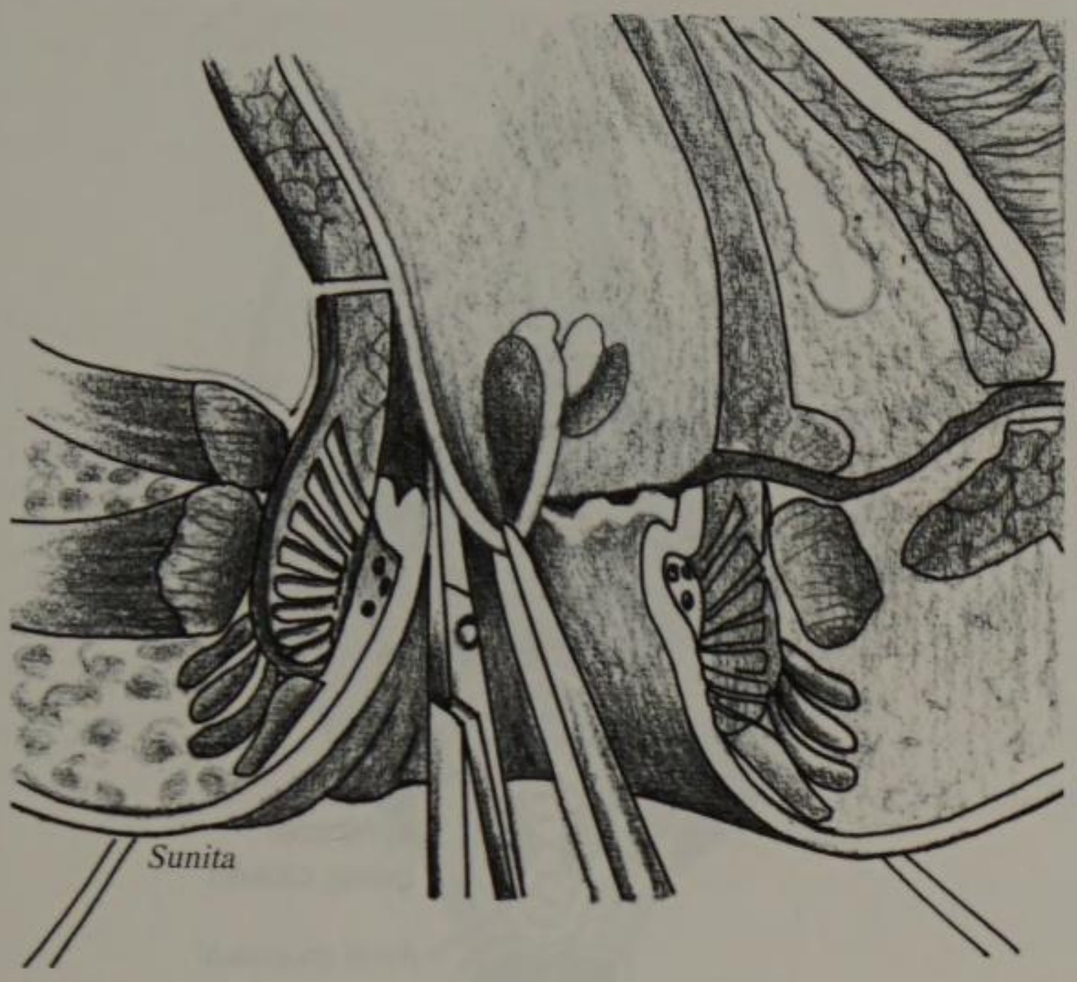

Fig. 46.8: Advancement rectal sleeve (ARS). Circumferential mobilization of rectum and anal canal sleeve

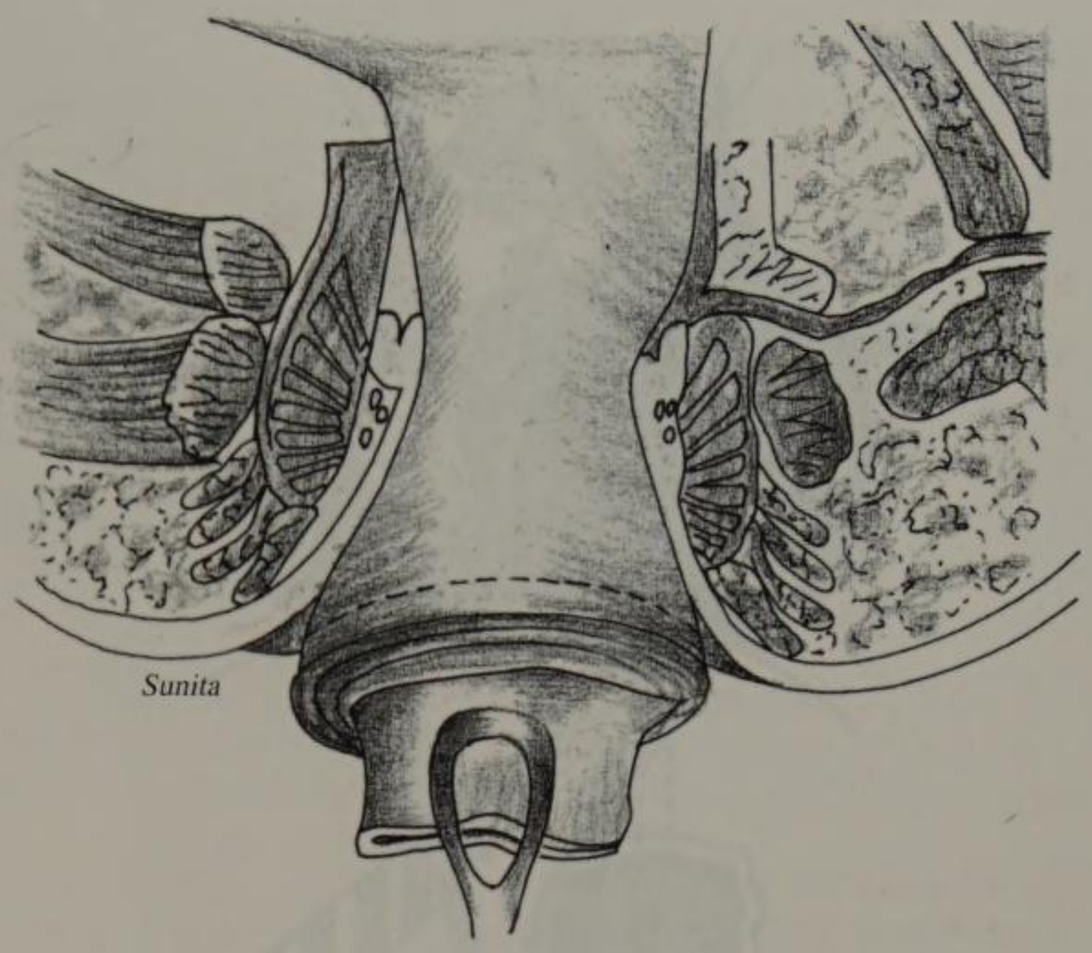

Fig. 46.10: Advancement rectal sleeve (ARS). Excision of diseased mucosa, followed by resuturing of rectal sleeve to anal canal

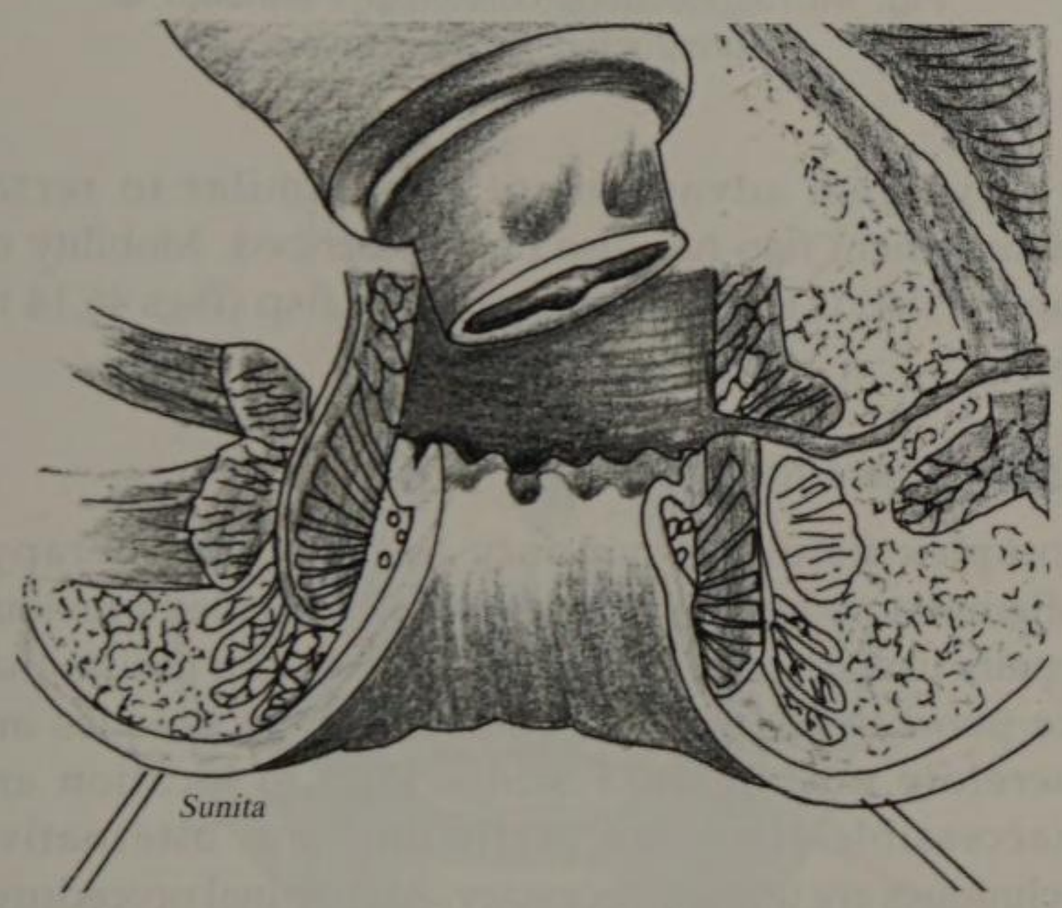

Fig. 46.9: Advancement rectal sleeve (ARS). Further mobilization of rectum up to level of peritoneal reflection

distorted, and transperineal approach gives an opportunity to excise the scar tissue and restore the anatomy to normal.

Simple fistulotomy, which involves the laying open of the fistulous tract, and healing by secondary intention, is mentioned only to be condemned. Except in the most superficial anovestibular fistula, it is likely to aggravate the problem of anal incontinence.

Perineoproctotomy, followed by layered closure is the recommended transperineal procedure. In this procedure the tissues between the fistula and perineum are cut, creating a fourth degree perineal tear (Fig. 46.11). All the fistulous tract and scar tissue is excised (Fig. 46.12). After adequate mobilization of rectal and vaginal mucosa, levator ani and the anal sphincters, tension free anatomical repair is done using delayed absorbable sutures (Fig. 46.13). Care is taken to restore high pressure zone in the anal region. The usual postoperative care is taken. In case of any doubt, a covering colostomy is made. Reported success of this procedure varies from 85% to 100%.[5]

A two stage perineoproctotomy, with incision of perineal bridge and excision of scar tissue in the first stage, followed by anatomical repair six to eight weeks later has been described. The authors have reported 100% healing rate in their series.[21]

Transvaginal Approaches

This approach is preferred by the gynecologists. It provides a better exposure of the fistula in comparison to the transanal route.

In the inversion technique a circumferential incision is given around the vaginal opening of RVF. The fistula is dissected up to the rectal wall. The fistula tract is excised, and a purse-string suture is placed around the opening in rectovaginal septum. Tying the suture inverts the fistula in rectum. Intervening tissues of rectovaginal septum are re-approximated and vaginal mucosa is closed.

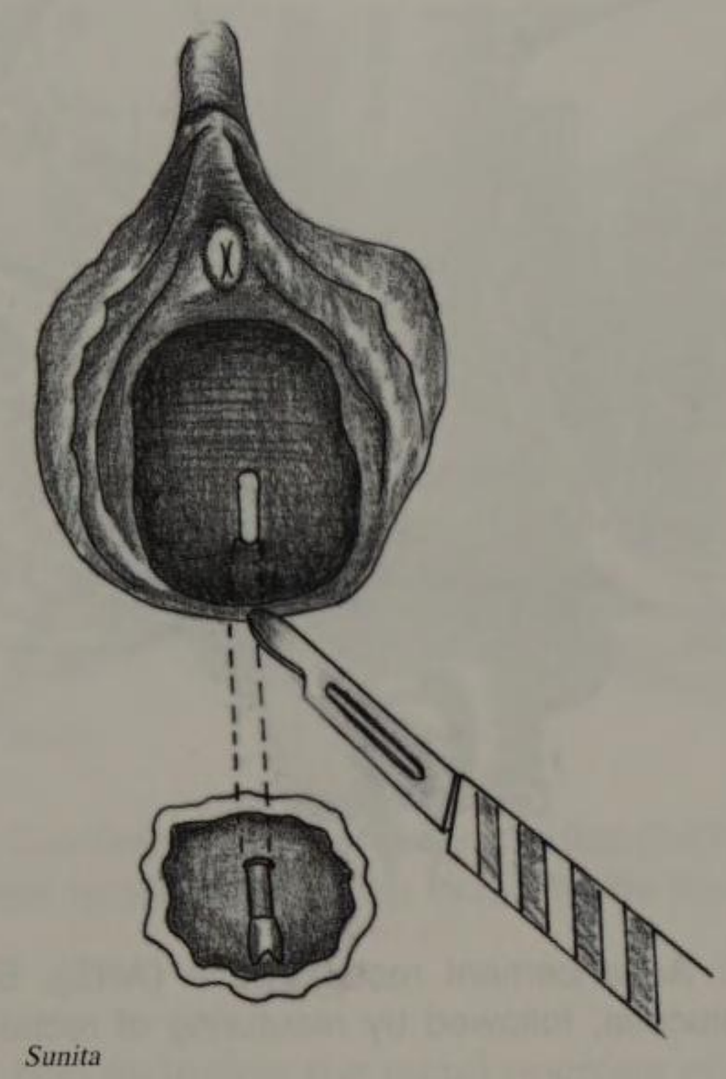

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Fig. 46.11: Perineoproctotomy. The bridge of tissue between fistula and perineum is incised with patient in lithotomy position

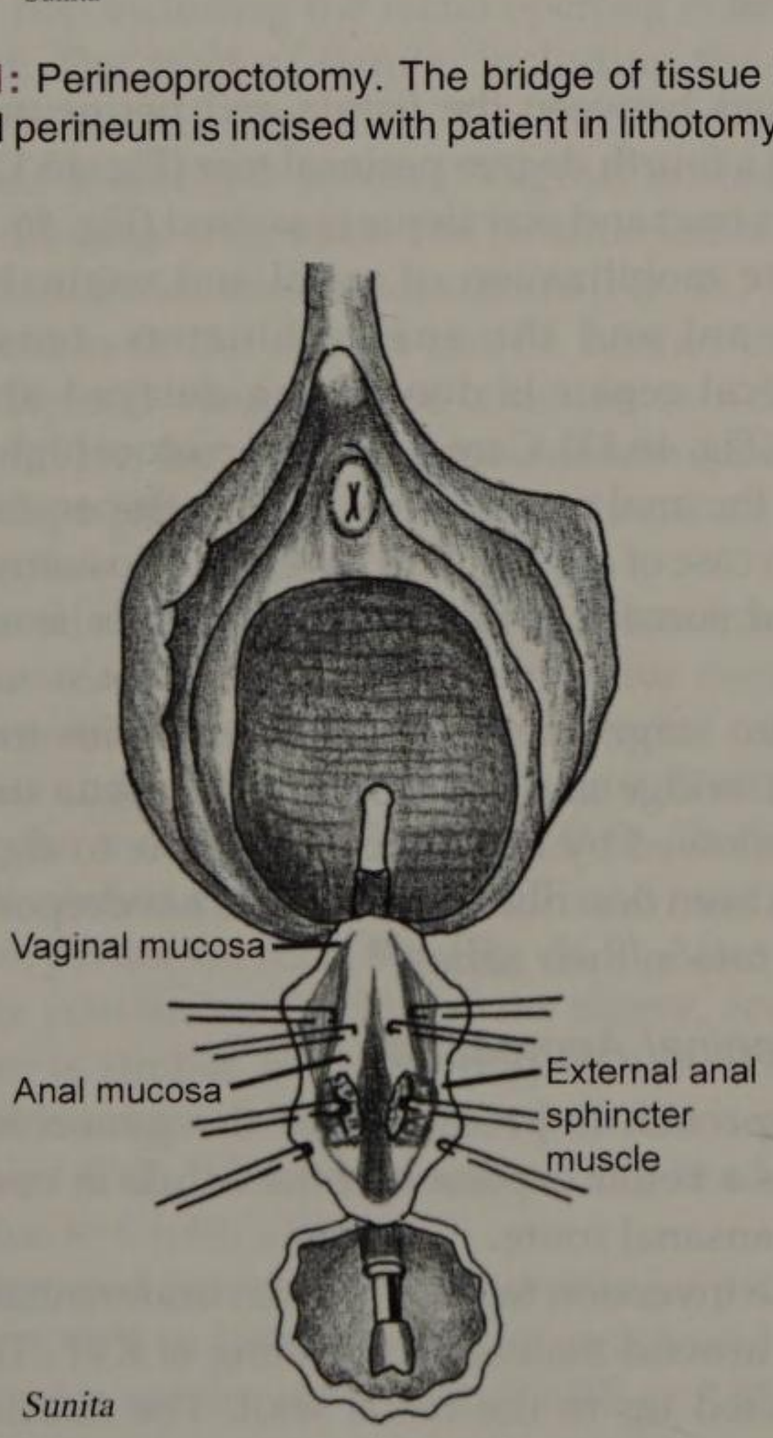

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Fig. 46.12: Perineoproctotomy. The four layers of vaginal mucosa, perineal body, internal sphincter and rectal mucosa are defined and dissected

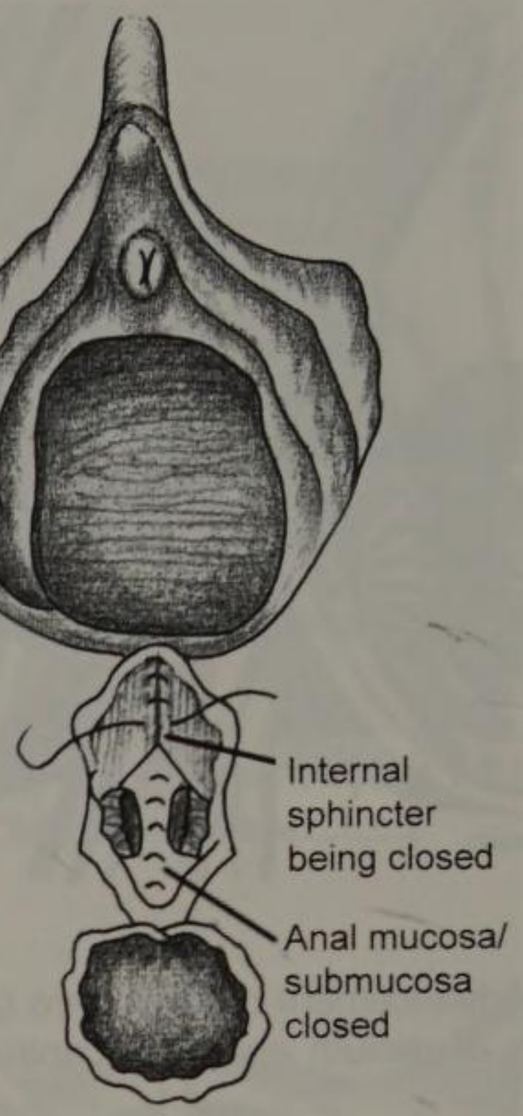

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Fig. 46.13: Perineoproctotomy. Perineum is reconstructed in four layers

A vaginal advancement flap, similar to rectal advancement flap has also been described. Mobility of vaginal flap is less than that of rectal flap (Figs 46.14 to 46.17).

Abdominal Procedures

Complex fistulas secondary to radiation therapy, inflammatory bowel disease, or multiple failed previous repairs usually have abnormal surrounding tissues that are poorly vascularized. Local repair techniques are therefore unsuitable. Fistulas high in location are inaccessible from the perineum, and alternative techniques are usually necessary. Abdominal procedures allow excision of all diseased tissue and interposition of well vascularized tissues to correct the problem. It is also sphincter preserving, as the approach does not violate the integrity of the anal sphincters.

The simplest of the abdominal procedures described involves mobilization of the rectovaginal septum, division of the high RVF, layered closure of the rectal and vaginal defects, and interposition of a pedicled graft, such as omentum, between the rectum and vagina. However, this method is successful only if normal tissues are available for the repair and the rectal compliance has

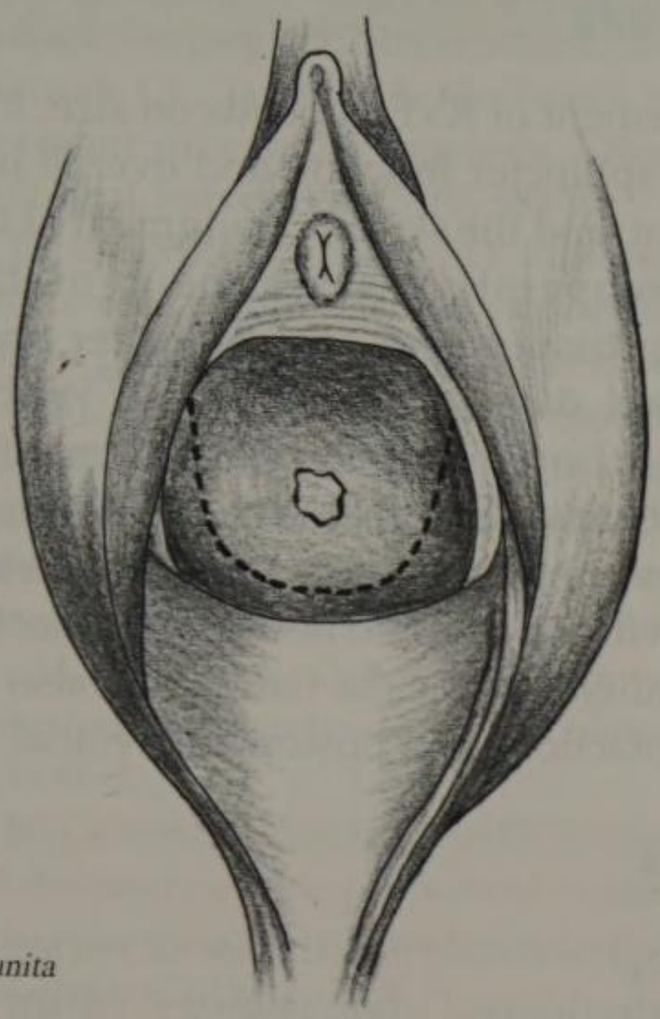

Fig. 46.14: Transvaginal repair. Curvilinear incision in posterior vaginal wall

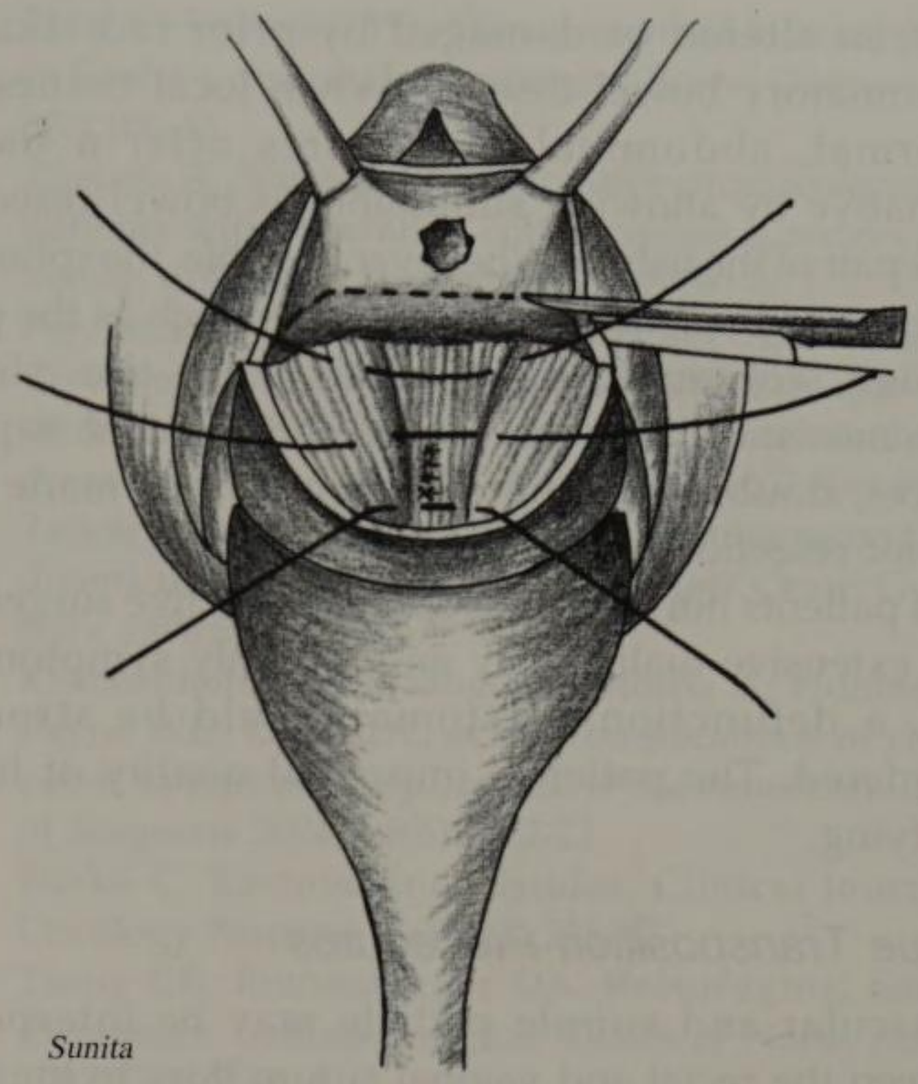

Fig. 46.16: Transvaginal repair. Levator ani muscles approximated in midline

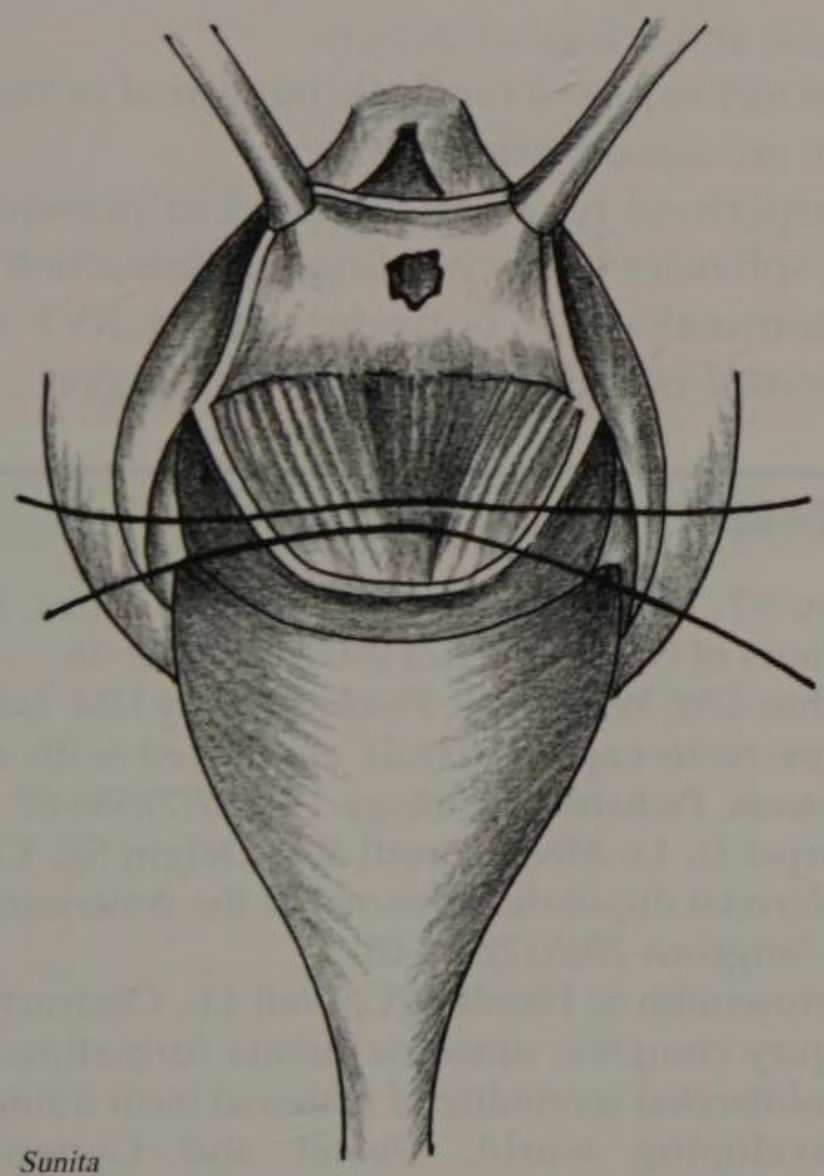

Fig. 46.15: Transvaginal repair. Vaginal mucosal flap raised, fistula debrided, rectal opening closed

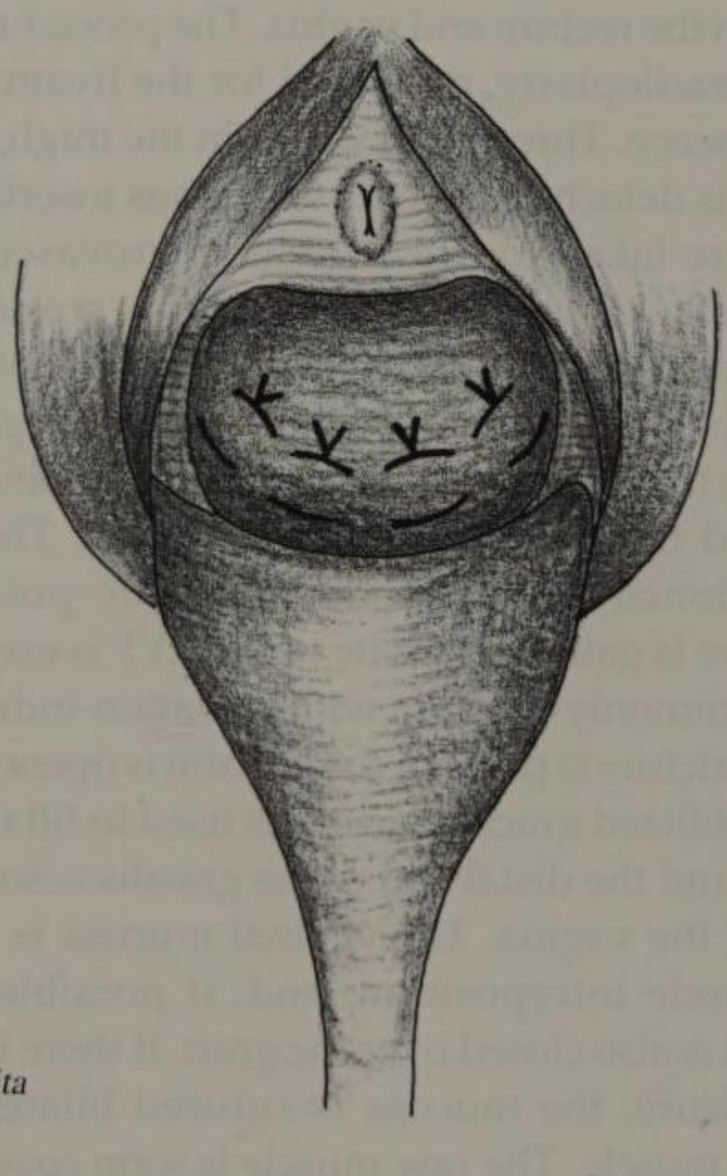

Fig. 46.17: Transvaginal repair. Distal vaginal flap excised, flap reapproximated

not been altered or damaged by prior radiation or inflammatory bowel disease. When local tissues are abnormal, abdominal procedures offer a useful alternative by allowing simultaneous bowel resection and repair of the fistula. Whenever possible, the sphincter is preserved by a variety of techniques such as the pull-through coloanal anastomosis and the sleeve anastomosis. With the advent of endoluminal stapling devices, double-stapling techniques have made low anterior resection a simpler alternative.[19]

In patients not fit for major reconstructive surgery or with extensive malignancy and a highly symptomatic RVF, a defunctioning stoma should be strongly considered. The patient's improved quality of life is gratifying.

Tissue Transposition Procedures

A vascular and supple pedicle may be interposed between the rectal and vaginal suture lines to improve the chances of healing. These procedures are indicated if local tissue is scarred.

In the Martius procedure, pedicled bulbocavernosus muscle is used. Neighboring muscles such as the sartorius and the gracilis can also be harvested and interposed between the rectum and vagina. The procedure is similar to the graciloplasty, described for the treatment of fecal incontinence. Through incisions in the thigh, the gracilis muscle is detached from its tendinous insertion distally, with care taken to preserve its neurovascular pedicle proximally. A subcutaneous tunnel is created from the proximal thigh wound to the perineum, anterior to the intact anal sphincter, and enters the rectovaginal septum distal to the RVF. The gracilis muscle is mobilized to that site, and the thigh wounds are closed. The patient is repositioned in the prone jack-knife position. Anal exposure is gained. The site of the RVF is excised, and if, as is commonly the case with radiation-induced RVF, a rectal stricture is present, the septum is opened vertically. The mobilized gracilis muscle is used to fill the resulting defect, and the distal end of the gracilis is sutured to the apex of the vagina. The vaginal mucosa is closed over the muscle interposition, and, if possible, the rectal mucosa is also closed over the graft. If there is tension on this closure, the mucosa is sutured bilaterally to the gracilis muscle. The raw muscle is soon covered by new epithelium. Because of the complexity of this procedure, a temporary diverting stoma is usually used. The reported success rates of this procedure range from 43 to 100%.[19]

CONCLUSIONS

The management of RVF depends on size, location, and cause; anal sphincter function and overall health status of the patient; and the skill and judgment of the surgeon. Careful preoperative assessment of the fistula, surrounding tissues, and anal sphincter and exclusion of associated disease are essential. With thorough evaluation, thoughtful consideration of treatment options, and meticulous operative technique, patients can be assured of an optimal outcome. Success in treatment of patients with RVF should be measured not just in terms of successful closure of the fistula but also in terms of patient satisfaction with postoperative anal continence.

Key Points

1. Rectovaginal fistula is a disease of varied etiology.
2. Symptoms depend upon etiology, nature of stools and presence of infection and incontinence.
3. Detailed history and clinical examination, including examination under anesthesia, are necessary to define the goals of treatment.
4. Investigations are required to identify the etiology and the type of RVF, as well as presence of bowel disease and sphincter defects.
5. Local techniques of repair through anal or vaginal route are equally effective.
6. Transperineal repair is indicated in presence of anal sphincter injury needing reconstruction.
7. Abdominal route is preferred for RVF with associated bowel disease requiring surgery.

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47

Rectal Prolapse with Anal Incontinence

Arun Gupta

INTRODUCTION

The condition of rectal prolapse has been known and described in ancient literature and patients were known to be hanged by the heels and shaken to reduce the prolapse. The early surgical procedures described were the Mikulicz procedure, a perineal rectosigmoidectomy, which was performed in 1889.[1] In 1912 Moschowitz performed a procedure, known by his name, in which he obliterated the perineal pouch using multiple purse string sutures.[2] He had noticed a deep rectovesical or rectovaginal pouch in these patients and proposed the theory of sliding hernia for etiopathogenesis of rectal prolapse. In 1965 Devadhar and in 1968 Broden and Snellman[3,4] studied the patients of rectal prolapse using cineradiography and proposed the theory of intussusception. In 1977 Parks et al[5] described that the mean resting anal pressures were decreased in rectal prolapse and proposed sphincter dysfunction as the cause. The etiopathogenesis of this condition still remains controversial.

Rectal prolapse occurs in people in the extremes of life. In children the incidence is highest in the first two years of life, is more common in males and is usually of the mucosal variety. In adults the prolapse is of a complete variety and is more common in women (Fig. 47.1). A very high percentage of the women are nulliparous.[6]

Many conditions are found associated with rectal prolapse. Patients with connective tissue disorder having increased joint mobility have been found to have this condition.[7] Rectocele, cystocele and uterine prolapse have been found associated.

Clinical Features

In children, mothers may notice discharge of blood and mucus or they may notice the prolapse. Adults notice

Fig. 47.1: Complete prolapse

the protrusion initially with exertion but later the prolapse may occur even on standing or walking.

Fecal incontinence is a frequent complaint in rectal prolapse. Some authors believe this is secondary to prolonged protrusion and stretch on the nerves.[5] Others have found decreased anal pressures in patients who are incontinent but normal pressures in continent patients.[8] It has also been observed that abdominal operations for rectal prolapse give better results than perineal procedures in incontinent patients.

Constipation is also associated with rectal prolapse in a significantly large number of patients. For patients who are severely constipated before surgery it is advisable to perform sigmoidectomy.

The patient can be examined in the usual left lateral position and asked to strain. If not discernible the patient can be asked to sit on the toilet and bear down and examined there.The tone of the anal sphincters should

be noted. If there is associated cystocele or rectocele this should be recorded.

Investigations

Sigmoidoscopy must be done to exclude a polyp or a neoplasm. Before deciding on the operative procedure certain functional aspects must be taken into consideration. Patients who have incontinence may need to have anal manometry done. This is done using a four-channel water perfused catheter connected to a transducer. The catheter is introduced into the anal canal and pulled out at one centimeter intervals and the pressures measured. These are the resting anal pressures. The catheter is then reintroduced, the patient is asked to maximally squeeze the anal sphincters and the pressures are measured again. These are called the maximum squeeze pressures. Patients who have very low anal pressures may remain incontinent even after surgery.

In patients who are constipated colonic transit time can be measured using ingested radioactive, radiopaque, nonabsorbable or colored substances. Patients with prolonged transit times can be considered for colectomy in addition to the fixation procedures.

Treatment

The management of rectal prolapse is surgery. The operations can be done by the abdominal or perineal routes.

Perineal Operations

Thiersch's Repair: The operation can be carried out using local anesthesia. Patient is put in the lithotomy or left lateral position. After infiltration of local anesthetic circumferentially around the anal opening in the subcutaneous plane two horizontal cuts are made, one at 12 o'clock and another at 6 o'clock position. A number 1 nylon suture on a 40 mm curved needle is passed subcutaneously from the anterior to the posterior opening. The needle is then reinserted from the posterior cut end to come out anteriorly. The suture is then tied over a 16-18 size hegar dilator in the anal canal. The two incisions are then sutured. Newer materials have been used over the years like sialastic rings[9] and polypropylene mesh.[10]

Fecal impaction is a frequent problem after this surgery. The wound may get infected necessitating removal of the suture. The prolapse would return once the wire is removed. The procedure is recommended for children as a temporary procedure or for the elderly ill patients who have limited life expectancy.

Altemeier operation (perineal rectosigmoidectomy): The patient is put in lithotomy position. The prolapse is brought down. About 1-2 cm distal to the anorectal junction an incision is made anteriorly through the full thickness of bowel and the peritoneal cavity entered. The redundant colon is delivered through this opening. At this stage plication of the levator ani muscles can be carried out. The redundant colon and rectum is then resected. Continuity is restored by anastomosing the cut end of colon with the distal rectal incision.

The recurrence rates of this procedure when done without levator-ani repair have been high.[11] Johansen et al[12] recommend that the procedure is safe and effective in the elderly specially those who are at significant risk of major abdominal operation.

Delorme operation: This is a modification of Altemeier procedure in which the bowel is not divided. The incision given just distal to the anaorectal incision is made only upto the submocosa and the mucosa is stripped circumferentially upto the apex of the prolapse. The redundant mucosa is excised and the denuded muscularis is plicated by a series of sutures.The edge of the incision is then closed.

Abdominal operations: This usually involves mobilization of the rectum and rectopexy or fixation of the rectum to the sacrum. It may be combined with resection of large bowel.

Ripstein procedure (Anterior rectopexy): The patient is placed in Trendlenburg position and a lower midline incision is made. The rectum and sigmoid colon are mobilized posteriorly after incising the peritoneum and entering the presacral space. The inferior mesenteric vessels and ureters must be safeguarded. A strip of polypropylene mesh, about 4 cm wide is then fixed to the scrum on one side. The mesh is sutured to the rectum covering its anterior two-thirds using nonabsorbable sutures on both sides. The mesh is then sutured to the sacrum on the opposite side. One of the drawbacks of the procedure is the possibility of bleeding if one enters presacral vein when fixing the mesh. The recurrence rates after this procedure are low[13] and this is one of the most common operations done for rectal prolapse.

Posterior rectopexy: To avoid the risk and difficulty of fixing the mesh in the hollow of the sacrum and to allow the rectum to distend freely the mesh in this procedure

is fixed to the rectum encircling it posteriorly (Fig. 47.2). The mesh is then fixed by two nonabsorbable sutures to the presacral fascia on either sides of the pubic promontory (Fig. 47.3). Recurrence rates of less than 2% have been reported.[14]

Frykman-Goldberg procedure (resection rectopexy): In this procedure the rectum is mobilized and fixed to the sacrum. In addition, the levator ani are plicated and the redundant sigmoid colon is resected. The procedure gives better functional results.[15]

Laparoscopic surgery for rectal prolapse: In the last decade the feasibility of laparoscopic surgery in the management of rectal prolapse has been demonstrated.[16,17] Mobilization of the rectum is done laparoscopically and the mesh attached to the rectum. The mesh is then fixed to the sacral promontory using laparoscopic tacker introduced transvaginally.

Fig. 47.2: Posterior rectopexy—Mesh being fixed to rectum posteriorly

Fig. 47.3: Posterior rectopexy—Mesh being fixed to the pubic promontory

CONCLUSIONS

Rectal prolapse is not an uncommon disease and is sometimes found in association with uterovaginal prolapse specially in elderly women. The treatment is surgical. Perineal route is rarely used. Abdominal operations like anterior or posterior sacropexy are done for this condition.

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48 Surgery for Stress Urinary Incontinence

Pranathi Reddy

INTRODUCTION

Stress incontinence is involuntary urine loss associated with sudden increase in intraabdominal pressure. The usual activities which produce this sudden increase in abdominal pressure are coughing, sneezing, jumping, running.[1] This definition does not differentiate between rise in bladder pressure secondary to rise in intra-abdominal pressure or detrusor overactivity. Taking this into consideration the ICS defined "involuntary loss of urine occurring when intravesical pressure exceeds maximal urethral closure pressure in the absence of detrusor overactivity" as Genuine Stress Incontinence. Since this is solely a urodynamic diagnosis the term Genuine Stress Incontinence has now been replaced with Urodynamic Stress Incontinence.[1]

Surgical procedures are more likely to cure **stress urinary incontinence** than non-surgical procedures but are associated with more adverse events. Surgical developments for management of this condition have been numerous with well over 150 described techniques. With reported cure rates (for surgical procedures) of 80% in 1914,[1] 84% in 1987[2] and 89% in 1999[3] it is obvious that we are still striving for an ideal operation. Three key issues which affected use of surgical intervention techniques were the concept of quality of life, the definition of cure for stress urinary incontinence and a better understanding of pathophysiology.

Definition of Cure

Assessment of the result of surgery for USI is complicated.[4] What is cure? Is it the absence of symptom as reported by patient? Is it the absence of sign demonstrated by clinician? Or is it a urodynamically demonstrated cure? One of the difficulties of assessing any continence procedure has been the choice of a suitable outcome measure. Simple cure of stress leakage is not sufficient as the occurrence of postoperative voiding problems and urinary urgency and frequency may have a profound influence on the outcome of surgery. Obtaining data on objective cure rates requires invasive investigations such as urodynamics which, although vital in clinical studies, are impractical in the majority of women undergoing routine surgery. A useful method of assessing outcomes, which has recently gained some popularity, is in measuring the effect of a procedure on quality of life before and after incontinence surgery with the means of validated and disease-specific quality of life questionnaires.[5] This allows relatively easy collection of a women's own assessment of subjective results in a standardized form. There are a number of obvious flaws in this method of assessing subjective results. Women may feel inhibited discussing the outcome of recent surgery with the surgeon who undertook the operation and may report the absence of symptoms when this is not the case. Surgeons, on the other hand, may tend to interpret results over optimistically.

Quality of Life Issues

Stress urinary incontinence rarely results in severe morbidity or mortality; rather it affects the quality of a person's life.[6] WHO defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Quality-of-life evaluations are an important adjunct to objective evaluations but can also stand on their own and provide important insight into the effect of the procedure on the patient herself. For example, a patient may be totally "cured" objectively of SUI as measured by stress test,

voiding diary, or pad test. However, she may not be emptying her bladder on her own, or she may have significant urgency with or without leakage. Thus, although "cured" of one problem, another may be created that can have a negative effect on patient satisfaction with the procedure and impact on quality of life. Use of questionnaire data is essential to our understanding of the impact of the procedure on patients in general, as well as providing information with which to counsel our patients. As recently reported[5] these validated instruments provide patient information that may be even more useful than an objective evaluation by a surgeon, which can be somewhat biased toward reporting success. When using questionnaires, the patient has control over her responses to the questions, and she acts as her own control, thereby reducing subjective differences between different patients. In this report, patients completed the evaluation in the privacy of their homes without the pressure of clinical staff or the operating physician.

Better Understanding of Pathophysiology

For the last couple of decades, gynecologic surgeons have based surgical recommendations on the distinction between whether the patient had stress urinary incontinence resulting from "intrinsic sphincter deficiency" or from "hypermobility," recommending a pubovaginal sling for the former and a colposuspension for the latter.[7,8] More recently, this dichotomy has been called into question, in that all women with stress incontinence have some degree of sphincter weakness, whether or not they have hypermobility.

SURGICAL TECHNIQUES

Based on available evidence at this time, colposuspension (such as Burch) and pubovaginal slings (including the newer midurethral synthetic slings) are the most effective surgical treatments.[9]

Burch Colposuspension

Urethra and bladder neck are supported by elevation of the paravaginal tissue to the ipsilateral ileopectineal ligament. Two to four sutures of No.1 PDS (Polyglycolic acid) or Ethibond are inserted into the paravaginal fascia. The initial suture is placed at the level of the bladder neck and subsequent sutures about 1cm proximal. These are then inserted into the ipsilateral ileopectineal ligament (Cooper's ligament). Once all the sutures have been positioned, each lateral fornix is elevated allowing the sutures to be tied without tension.[10]

Laparoscopic Colposuspension

A laparoscopic colposuspension uses the same principles as open colposuspension with the additional advantages of low morbidity and short in-patient stay.

Transperitoneal approach:

- Upper border of bladder can be demarcated by filling with 300 ml of saline.
- Allows visualization of other pelvic organs.
- Can undertake concomitant pelvic surgery.
- Peritoneal closure not required.

Extraperitoneal approach:

- Can use direct insufflation or balloon dissection to approach Space of Retzius
- Provides less room to operate.

The use of standard suture materials or clips and prolene or mersilene mesh have also been described. The incidence of urinary tract injury is higher with the laparoscopic approach. Published series are few, but two reports of ureteric injury, (a very unusual occurrence at open surgery, with only 15 cases reported in the literature[11]) suggest that the risk of lower urinary tract injury may be much greater with a laparoscopic approach.[12]

The major drawback is the relatively long learning curve taken to gain proficiency in order to be able to perform laparoscopic Burch colposuspension. Although laparoscopic colposuspension appears to offer low morbidity and early return to work, the poorer long-term results and higher rate of urinary tract injury suggest that the open approach remains preferable.

Cure rates vary depending on the study but rates of 90.6% at 2 years have been reported.[13]

At present its role is limited to being the most appropriate bladder neck suspension surgery in cases where laparoscopic surgery for another indication is being carried out by an endoscopic surgeon in a woman with urodynamic stress incontinence.

Slings

The common feature of sling operations is the use of a strip of material, which is passed completely beneath the urethra or bladder neck and anchored to a point on the abdominal wall.

It is the choice of material and tension which appear to influence most, the outcome of sling surgery. Pubovaginal slings using both autograft and allograft fascia have been used in the treatment of urinary incontinence secondary to intrinsic sphincter deficiency (ISD) in the presence of a hypermobile urethra. Aldridge[14,1] was the first in managing a series of patients with stress incontinence to use autologous rectus fascia to encircle the urethra. This makes dissection extensive and there is necessity for closure of fascial defect using mesh abdominally.

More recently, autologous or allograft fascia lata has been used with success rates of 78 to 98%.[15, 2] The use of cadaveric fascia lata (CFL) has several advantages over autologous fascia lata, including avoidance of second operative site for fascial harvesting, which can have an impact on the size of the incision, increase blood loss, operative time, and postoperative pain and delay hospital discharge. Where available, cadaveric fascia lata has gained acceptance, making it possible to avoid additional surgery and potential complications inherent in harvesting autologous fascia.[16, 6]

Another approach reducing the complications of graft harvesting has been ability to use synthetic sling materials. While synthetic materials are easily available, all share the disadvantage of local tissue reaction leading to persistent local infection or erosion[17] (Table 48.1).

Table 48.1: Artificial sling materials used for suburethral slings

Trade name	*Composition*	*Comments*
Mersilene	Polyethylene terephthalate	Multifilament fibers; very porous, becomes firmly embedded in native tissues
Marlex, Prolene	Polypropylene	Monofilaments with open weave patterns
Teflon	Polytetrafluoro-ethylene (PTFE)	Multifilament
GORE-TEX	Expanded PTFE	Very flexible
Silastic	Silicone plus woven polyethylene terephthalate	Minimal tissue reaction, which facilitates removal or revision if necessary
Protogen	Synthetic mesh impregnated with collagen matrix	Removed from market owing to unexpectedly high rate of vaginal extrusion

Results of Sling Surgery

Jarvis[18] in a meta-analysis of all surgery for stress incontinence found an objective cure rate of 85.3% and a subjective cure rate of 82.4%. These figures agree closely with the results of the American Urological Association,[19] who report an overall subjective cure rate of 82%.

The Tension Free Vaginal Tape (TVT) Procedure

The TVT procedure was first described in 1996,[20, 6] as an ambulatory procedure under local anesthesia and sedation, involving insertion of a polypropylene tape suburethrally.This relatively new technique is based on the premise that stress incontinence results from failure of the pubo-urethral ligaments in the mid-urethra which led to the proposal of 'an integrated theory for the maintenance of female stress incontinence'.[21] In this model, continence is maintained at the mid-urethra and not at the bladder neck.

The TVT procedure uses a knitted prolene mesh tape placed at the mid-urethra.[22] The tape is inserted via a small vaginal incision using two 6 mm trocars. After bilateral paraurethral dissections of the vaginal wall, the trocar and tape was placed through the urogenital diaphragm into the retropubic space close to the back of the pubic bone up to the skin incision on anterior abdominal wall which have been placed suprapubically on either side of pubic tubercle. The same procedure was performed on the other side. Cystoscopy was subsequently performed to verify the absence of bladder injury. Then, the tape was adjusted without tension in a U-shape-around the midurethra. Due to the weave of the tape it is self-retaining. The aim is to have the tape lying free at rest (hence 'tension free') and to only exert sufficient pressure on the urethra during a cough to prevent leakage of urine. The mean operating time was 28 to 29 minutes A multicentre study carried out in six centres in Sweden on women with no previous surgery for incontinence showed a 91% cure rate after one year.[23] Hilton and Ward have recently published results. Their results show an 88% objective cure rate as a primary procedure and 75% as a secondary procedure.[24]

Trans Obturator Tape (TOT) Procedure

A variation of TVT to reduce the complication of bladder perforation and transmuscular insertion, through the obturator and puborectalis muscles, reproduces the natural suspension fascia of the urethra while preserving the retropubic space. A 20-mm incision was made on

the anterior vaginal wall and the middle urethra was identified. The dissection was stopped when the index finger inserted through the incision entered in contact with internal surface of the ischiopubic bone and obturator foramen. A 5-mm vertical skin incision was made on the internal surface of the thigh, a maximum of 10 mm above a horizontal line passing by the level of the urethral meatus, and 10 mm outside the ischiopubic ramus. A curved tunneling tool was introduced vertically just to perforate the superficial aponeurosis and the index finger of the contralateral hand was placed into the vaginal incision to check the path driving the tunneling device. Visual checks were conducted to control that the tunneling device had not perforated the lateral part of the vagina. The TOT sling was inserted into the eye of the tunneling tool and passed backward through the obturator foramen by removing the device. The same operation was performed through the contralateral obturator foramen. The tape was placed in a transversal, frontal plane between the urethra and vaginal anterior wall without any suspension action. No cystoscopy was required for the procedure.

Anterior Colporrhaphy

Kelly described the excision of a portion of anterior vaginal wall and plication of the paravesical tissue, at the bladder neck, and paravaginal fascia as a primary treatment for Urodynamic Stress Incontinence (USI). Until recently, anterior colporrhaphy was widely used as primary treatment for USI.

However, the relatively poor medium to long-term cure rates have lead increasingly to the use of alternative procedures.[25] Anterior colporrhaphy should be reserved for treatment of prolapse alone. However, in a frail elderly woman whose main symptoms are of prolapse but with mild USI, insertion of 'Kelly' buttress sutures to the bladder neck may be appropriate. The procedure has a low morbidity and relatively little postoperative pain allowing early mobilization and discharge from hospital.

Injectable Peri-uriurethral Bulking Agents

The use of injectable peri-urethral bulking agents is gaining popularity. The mechanism of continence achieved after peri-urethral injection is not well defined. It is thought that peri-urethral bulking achieves better apposition of urethral epithelium without an increase in obstruction.[26] As peri-urethral injectables act by co-apting the urethral muscoa and increasing urethral closure pressure it has been suggested that they would be particularly suitable for women with stress incontinence due to intrinsic sphincter deficiency.

Injections may be made either transurethrally via a cystoscope of peri-urethrally under cystoscopic control. It has also been suggested that peri-urethral bulking agents may have a place in the treatment of women who wish to have further children.[27] In general, the medium to long-term results of this form of treatment are poor and, while it is claimed that injection has no effect on future surgery, it is possible that fibrosis, from repeated injections, may lead to a decline in intrinsic sphincter function. For this reason, use of this technique as a primary procedure should done with extreme caution.

A number of materials have been used for peri-urethral injection. The ideal material would be completely inert, cheap, easy to inject and free from long-term complications, yet provide long-lasting results. Teflon was the first widely used peri-urethral injectable material. Teflon was found to produce dense fibrous tissue and granulomatous reaction leading to urinary obstruction, urethral erosion and severe problems with any subsequent surgery. As a result of these problems, Teflon is now rarely used. One of the most common materials used currently is gluteraldehyde cross-linked bovine collagen (GAX collagen). This has not been shown to have any side-effects due to migration, but does produce a local inflammatory response in which injected collagen is replaced with endogenous collagen.[28] Due to the inflammatory response produced by GAX collagen and the resorption of this material, repeated injections may be necessary to sustain continence. Another widely used injectable material consists of micronised silicone rubber particles suspended in a non-silicone carrier gel. This is currently marketed as Macroplastique (Uroplasty, Reading, UK). The larger particle size of this material makes migration and displacement less likely and, in addition, the inert nature of the material makes a local inflammatory reaction less problematic. The silicone particles are designed to act as a bulking agent with local inflammatory response removing the carrier gel, encapsulating the silicon in fibrin and replacing the gel with collagen fibres. Cure rates reported with Macroplastique are similar to those with GAX collagen vary from 7 to 83%.[29] Injectable materials are expensive; however they are invaluable in the treatment of secondary incontinence in women who have undergone multiple failed procedures or after radiotherapy where

the urethra is fixed and scarred, a group of patients for whom other techniques have high morbidity and poor results.

POSTOPERATIVE COMPLICATIONS

Voiding Difficulties

Voiding difficulties are a potential problem of all continence surgery. They are particularly common in patients with flow rates of less than 15 ml/Sec or maximum voiding detrusor pressure below 15 cm H_2O on pre-operative urodynamics.[30] The relatively high incidence of voiding difficulties following sling surgery has been one of the most significant factors preventing more widespread use of this technique.[31] Recently, the importance of avoiding excessive sling tension has been recognized. There is a trend for slings to be placed under less tension, or even completely loose, and this may reduce the incidence of voiding dysfunction.

Over-elevation of the urethra and bladder neck is associated with a high incidence of voiding difficulties. A number of techniques for avoiding and correcting excessive sling tension have been advocated. Various intraoperative techniques to gauge correct sling tension have been described, including measurement of Q-tip angle, intraoperative UPP and cystoscopy, although there is no convincing evidence that they correctly determine appropriate sling tension. Avoiding excess tension appears to rely mainly on the experience of the surgeon. When obstruction occurs postoperatively, simple urethral dilation has been suggested which may produce temporary relief but also progressive worsening of the obstruction due to peri-urethral fibrosis.

De novo Detrusor Instability

It has been shown that detrusor instability arises *de novo* in 12 to 18.5% of women postoperatively.[32] It occurs more commonly following previous continence surgery. It seems likely that a number of cases reflect pre-operatively. In addition, it has been suggested that damage to the autonomic nerve supply occurs during lateral displacement of the bladder at operation.

Enterocele and Rectocele Formation

This occurs following Burch colposuspension and is thought to occur as a result of elevation of the anterior vaginal wall creating a posterior defect and causing intra-abdominal pressure to be transmitted directly to the posterior vaginal wall. The incidence of postoperative posterior compartment defects is estimated to be 7-17%.[33] It is not clear whether these represent new defects of merely a pre-existing defect becoming symptomatic once the support of the anterior vaginal wall has been rectified.

Graft Erosion

Problems related to erosion of the sling material, either through the vagina or urethra, appear to be encountered almost exclusively with synthetic sling materials. Although the incidence of such problems is low, graft erosion can present with persistent vaginal discharge, vesicovaginal fistula formation and fibrosis and destruction of the urethral sphincter.

FACTORS AFFECTING THE OUTCOME OF SURGERY

1. *Age* appears to have an influence on the failure rate of continence procedures in general. Hilton showed a decrease in success with increasing age likely to be due to atrophic tissue changes with poorer healing, combined with the normal loss of urethral closure pressure that occurs with age. These changes may be partly reversible with preoperative estrogen replacement.
2. *The tensile strength of collagen* may also influence the results of surgery. Those patients with weaker collagen are likely to have earlier failure. Currently interest in collagen status is growing, but it is not possible to predict results based on collagen biopsy at present.
3. *A well chosen primary procedure* ensures the highest success rates There is an increased risk of postoperative detrusor instability with successive operations, presumably due to increased denervation. Complication rates rise as, with each successive operation, dissection becomes more difficult and wound infections and haematoma formation become more likely. Sphincter function may be adversely affected by denervation. This is not to say that secondary surgery cannot have reasonable success rates, but it is clear that a woman's best chance of long-term cure is with the first operation. In the light of this, it is no longer appropriate to perform an operation with lower morbidity, such as an anterior colporrhaphy, first, then proceed to a needle suspension and finally when this fails to attempt a sling procedure.

4. *Preoperative assessment and appropriate patient selection*: Controversy still surrounds the need for urodynamic assessment prior to surgery and some gynsecologists and urologists are prepared to undertake surgery without prior investigation. While it is reasonable to offer a short trial of conservative therapy based on clinical history and examination it would be unwise to undertake ANY major surgical intervention without thorough preoperative investigation and evaluation. Surgical treatment of USI should be no exception to this rule.

The symptom of stress incontinence may be produced by detrusor instability in the absence of anatomical disorder; bladder neck surgery will not lead to any improvement in symptoms and is in fact likely to worsen the underlying detrusor instability.The presence of detrusor instability pre-operatively has been shown to have a major impact on the success of colposuspension. Stanton et al demonstrated a significantly reduced cure rate in such patients compared to those with genuine stress incontinence, (43% compared to 83%).Where detrusor instability and urethral sphincter incompetence co-exist, it is recommended to treat detrusor instability, before surgery, using anticholinergic medication and to reassess urodynamically once irritative bladder symptoms are controlled, before considering surgical treatment of stress incontinence.

Preoperative urodynamic studies also allow the assessment and prediction of voiding dysfunction. This allows adequate preparation of women at high risk of postoperative voiding difficulties; counseling can be provided and clean intermittent self catheterization (CISC), taught prior to surgery. While clinical diagnosis may often be correct in detecting USI, the value of pre-operative urodynamics in helping to predict outcome and prevent inappropriate surgery is undeniable. Both clinically and medicolegally, it is becoming increasingly difficult to justify surgical intervention without thorough urodynamic investigation.

CONCLUSIONS

The ideal surgery would be one which has a high success rate and minimal adverse impact, is enduring and cost-effective, can be widely used and be combined with other procedures for prolapse.

Key Points

1. Quality of life issue: First do no harm.
2. Conservative options should be tried first.
3. Patient should be aware of all treatment options.
4. Knowledge of patient expectations from treatment.
5. Myth: Stress incontinence and surgery are synonymous.
6. Aim for a level of dryness with which patient is comfortable.
7. Complications of continence surgery may sometimes be worse than the original problem.
8. Decision to operate is patient driven.
9. Video demonstrations of TVT and TVT-O by JB Sharma provided in DVD-ROM.

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Section IX

Postoperative Care

GOOGLE

49 Postoperative Management in Vaginal Surgery

Shalini Rajaram, Rashmi Khatri

INTRODUCTION

Aim of surgeon in postoperative period should be to decrease morbidity of patients and prevention or early recognition of postoperative complications. The most critical period of a patient's postoperative course occurs within the first 72 hours of surgery. Precise monitoring of cardiovascular system, renal and respiratory system provides the most valuable information about patient's postoperative condition. Patients at risk of developing venous thrombosis should be identified and appropriate prophylaxis should be administered.

Postoperative Instructions

After completion of surgery postoperative orders should be written clearly in the case sheet.

1. Patient's name
2. Date of surgery
3. Diagnosis and name of surgery
4. Surgeon's name
5. Condition when patient left OT table
6. If allergic to any drugs (specify)
7. Vitals to be monitored (15 min until stable, 2 hours for 24 hours, 8 hours if stable)
   - Pulse
   - Blood pressure
   - Respiratory rate
   - Temperature
8. NPO – specify
9. Intravenous fluids
10. Input charting
    Output charting
    - Drains
    - Catheters
    - Nasogastric
11. Analgesics
    - Dosage
    - Route of administration
12. Antibiotics
    - Dosage
    - Route of administration
13. Antiemetics
    - Dosage
    - Route of administration
14. Other medications like for venous thrombosis prophylaxis, patients of heart disease, hypertension, respiratory diseases, etc.

A thorough examination of vital signs, drains, pulmonary status, abdominal status and local examination of wound should be done before patient leaves postoperative room.

Routine hematocrit, hemoglobin should be done on the morning of day after surgery. A urine culture and sensitivity should be done before removing the catheter in postoperative period. If positive culture, give proper antibiotics.

Deepened breathing should be encouraged as soon as patient becomes conscious. Patient should be encouraged to begin flexing her legs, bending her ankles and gently moving from side to side. Position can be changed in bed. Patient can be encouraged to sit on a bedside chair for few minutes for 3-4 times a day beginning the day after surgery.

Bowel movements should be resumed by the third postoperative day. Gentle laxatives with a stool softener should be given when patient starts eating solid food. If no bowel movement occurs on the evening of third postoperative day Dulcolax (bisacodyl) or saline enema can be given.

Fluid Replacement

Most minor and major procedures do not require peri and postoperative intravenous fluids. Patients undergoing day care procedures can be allowed orally after recovering from anesthesia.

For major surgeries, fluid replacement is given to replace for blood and fluid loss during surgery and decreased intake postoperatively as a result of anesthesia.

Average patient requires 2.5 to 3 litres of fluid per 24 hours and at least 75 to 100 mEq of sodium and 60 mEq of potassium per day. Potassium loss may be increased by persistent vomiting and replacement should be given. Crystalloid solutions are used for perioperative fluid replacement. Ringer lactate is preferred to normal saline, but in cases when there is a hyponatremia or in presence of brain injury, normal saline is preferred.

Conditions requiring additional fluid replacement are:

1. High fluid loss through a drain like inguinal drains following block dissection of inguinal lymph nodes.
2. Long surgery – loss 1 litre/hour
3. Pyrexia – 15% extra per 1°C rise of body temperature.
4. Patients with ileostomies and colostomies may drain 3 to 4 litres/day.
5. Patient developing ileus in postoperative period sequesters 1 to 3 litres of fluid per day in bowel lumen, bowel wall and peritoneal cavity.

Patient in postoperatoive period can have fluid overload. A patient who is gaining in excess of 150 g/day is in a state of fluid expansion. Simple fluid restriction will correct the abnormality or urinary diuretics can be used to increase urinary water excretion.

Diet and Bowel Action

If the operative site has not involved the intestine, patient should be encouraged to eat a few sweet biscuits or a dry toast within 24 hours of operation. Diet should be built up gradually. Foods containing protein and potassium are particularly required.

After perineorrhaphy, while it was customary to delay bowel action if possible until the fourth or fifth day, it is of no consequence if it occurs earlier. After the repair of a complete perineal tear and rectovaginal fistula the aim is to delay bowel action for 7 to 8 days by giving a low-residue diet. At the end of that time an enema should never be given because the nozzle can damage the operation site. A suppository together with a mild laxative should be enough.

The total parenteral nutrition (TPN) is occasionally required in patients with cancer or impaired oral intake and bowel function. Any patient who cannot eat for more than a week should be put on TPN, and this decision should be made sooner rather than later. A peripheral or central access is used. TPN provides all the essential and trace element components of the diet but may vary depending on the presence of other metabolic and endocrine conditions.

Postoperative Analgesia

Excessive pain in early postoperative period should not be dismissed as may be due to tight vaginal pack which may need removal or due to paravaginal hematoma requiring inspection of area concerned.

Inadequate analgesia in postoperative period reduces deep breathing leading to impaired oxygenation of tissues, causing increased chances of atelectasis, prolonging hospitalization.

Patients undergoing day care surgery should be given suitable oral analgesics to be used at home. Simple techniques such as infiltration of incision site and application of analgesic patches may be of benefit. Studies have shown that paracervical block with a 0.5% bupivacaine with 1:200,000 epinephrine before vaginal hysterectomy is associated with lower pain scores and a reduction in morphine requirement after surgery.[1]

Patient controlled analgesia (PCA)[2] system has been introduced allowing patient to control the rate and level of analgesia. These devices are electronically controlled infusion pumps which deliver a preset dose of narcotic to a patient's indwelling intravenous catheter. Patients using PCA system have been shown to have improved analgesia, a lower incidence of postoperative pulmonary complications. Furthermore the total dose of narcotic used has been lower with PCA than with conventional intramuscular depot injections.

Subarachnoid block for vaginal surgery produces superior postoperative analgesia than general anesthesia. A significantly better postoperative analgesia was present in the subarachnoid group and the duration was consistent with the expected action of intrathecally administered drugs. Two weeks after surgery a higher percentage of patients in the subarachnoid group reported no pain.[3] In patients undergoing extended surgery epidural analgesia may be employed. This reduces the depth of anesthesia required and improves pain relief after surgery. Hypotension can occur but should respond to volume replacement. Compared with

analgesics administered I.M. or I.V., epidural analgesia has been shown to be associated with improved pulmonary functions postoperatively, a lower incidence of pulmonary complications, a decrease in postoperative venous thromboembolic events (most likely secondary to early ambulation), fever, gastrointestinal side-effects, lower incidence of CNS depression.[4] Non-steroidal analgesics and tramadol are useful once the acute pain has started to subside. Long acting agents or preparations such as diclofenac and ketoprofen, given as suppositories provide effective analgesia and are less traumatic than repeated intramuscular injections.

In addition to analgesics a hypnotic is usually desirable at night initially. Sometimes this may have to be continued even when the physical discomforts of the operation have passed. There is always a reaction to the mental stress of an operation, and the relatively inactive life in the strange atmosphere of the hospital is not conducive to sleep. There is little need to fear a drug habit; patients give up the hypnotic as soon as they are convalescent.

Antibiotic Prophylaxis

Risk factors for postoperative infections are:

1. Radical surgery for gynecological malignancy.
2. Bacterial vaginosis.
3. Excessive blood loss at the time of surgery.
4. Prolonged operative time.
5. Poor nutrition.
6. Diabetes mellitus.
7. Surgery in an infected operative site.

Prophylactic antibiotics have been used in an effort to reduce these infections. The timing of administration of the prophylactic antibiotic agent is important. It should be given 30 minutes before the surgery.

Infections observed after gynecologic surgical procedures are polymicrobial and require parenteral broad-spectrum antimicrobial therapy until the patient has been afebrile for 24 to 72 hours.[5] Therapy should be tailored to the specific infection and patient response thereto. When the infections are complicated by abscess or infected hematoma, combination therapy appears to be effective in a shorter period of time, and surgical drainage is infrequently necessary other than drainage of those in the supravaginal, extraperitoneal space. Administration of antibiotics immediately before surgery to women at high risk for postoperative infection has essentially eliminated pelvic infections.

The first and second generation cephalosporins are well suited for this purpose because of their activity against gram-positive, gram-negative and anaerobic organisms. Most classes of drugs including penicillins, tetracylines, metronidazole, clindamycin are shown to be effective prophylactically, but none has shown to be more effective than cephalosporins. Pre and post-operative treatment for at least 4 days with metronidazole reduces significantly vaginal cuff infection among women with abnormal vaginal flora.[6] A short course of prophylactic antibiotics was as efficacious as a longer course in preventing postoperative infection. It was also cost-effective.[7]

Management of Catheters

Indwelling urinary catheters should be used in major pelvic surgeries. This is done to reduce the risk of bladder damage at the time of surgery and for patient comfort in the acute recovery phase. Following uncomplicated surgeries once the patient is able to get out of the bed, catheter must be removed.

Despite recatheterization rate, early removal of indwelling catheters immediately after uncomplicated hysterectomy seems to decrease first ambulation time and hospital stay.[8]

Extended bladder drainage is required in:

1. When bladder opened during surgery (7-10 days).
2. Anterior colporrhaphy (48-72 hrs).
3. VVF (10-14 days).
4. Surgery for SUI.
5. Vaginoplasty.
6. Urethral surgery.
7. Surgery for gynecological malignancies like vulvectomy. Indwelling urinary catheter should be used until initial healing of skin edges occurs.

The suprapubic bladder drainage is performed during bladder neck surgery, radical surgery, surgery for VVF and stress urinary incontinence (Fig. 49.1). This allows residual urine volume to be measured after spontaneous voiding. Suprapubic catheters are removed when residual urine is less than 100 ml.

Urinary retention is a common complication after prolapse surgery requiring recatheterization. If after removal of catheter, the patient is still unable to void in adequate amounts, she may be taught the technique of self-catheterization. Alternatively, she may be discharged with a Foley's catheter in place and clamped. The clamp

Fig. 49.1: Suprapubic catheter

is to be opened and the bladder drained periodically as necessary. It should be explained that the temporary inability to void is by no means rare or unusual and will probably not lengthen or change her convalescence (Fig. 49.2).

It has been seen that domestic use of a transurethral Foley's catheter is a valid alternative to intermittent or suprapubic catheter if normal micturition is not easily restored. It is however experienced as a relatively unpleasant by more than one-third of the patients.[9]

In patients undergoing surgeries for stress urinary incontinence, postoperative bladder care is most important. Patient should be encouraged to void every two hours after removing catheter because over distension causes irreparable damage to the bladder. Suprapubic drainage is alternative to this prolonged catheterization. The risk of postoperative voiding dysfunction (POVD) after colposuspension increases with age. Studies have shown that in women over 65 years consideration should be given to an elective temporary discharge from hospital with a suprapubic catheter *in situ* for 7 to 10 days before initiating a catheter-clamping regimen.[10]

In patients with VVF, bladder irrigation should be done to clear a blocked catheter. Both transurethral and suprapubic catheters are used simultaneously (Fig. 49.3). An adequate intake of fluid is required so that an adequate urine output can be maintained. High output of diluted urine should be maintained preferably as much as 100 ml/hr.

Care of Suprapubic Catheter

Under many circumstances, the doctor may wish to put the recently repaired tissues around the urethra, bladder, and vagina at complete rest while they recover from surgery, and a catheter will be placed into the bladder through a tiny incision in the skin of the lower abdomen. This is a temporary way of diverting the urine until the patient's own bladder system is able to function again and does save a patient the nuisance, discomfort, and irritation from repeated catheterization during the healing process.

When voiding trials are to be begun the suprapubic catheter should be clamped, and the patient should be instructed to void on a regular schedule. The patient

Fig. 49.2: Clamping of transurethral catheter

Fig. 49.3: Both transurethral and suprapubic catheters *in situ* after VVF repair

should measure the amount of urine that she is able to pass, and the catheter should then be opened and allowed to drain for 20 minutes. The urine thus obtained should be recorded as the postvoid residual, and the catheter should then be reclamped. This catheter regimen allows both the volume voided and the residual urine to be checked regularly without the need for nursing personnel to insert and remove a transurethral catheter continually. When the voided volumes are large and the residuals are small (about 25% of the volume voided), the suprapubic catheter can be removed.[11] The catheter is removed by extraction after simply cutting across its midpoint. The opening left by the catheter will usually close within a day or two, but a small amount of urine will often drip at first from this opening, requiring a small dressing until the opening has closed. If the patient is unable to void, the catheter can be opened every two hours to drain overnight, giving the patient a good night's sleep without the need to insert and remove a transurethral catheter.

Suprapubic catheters can be left in place for six weeks if needed. When they are left in place longer, they usually become encrusted and clogged. This can sometimes be delayed by the use of ascorbic acid in large doses, 3 gm by mouth three times per day.[11] If suprapubic catheterization is needed for longer than six weeks, the catheter must be changed.

Long-term drainage of the bladder with a transurethral catheter should be discouraged. It is uncomfortable, irritating, and can lead to irreparable damage to the bladder neck, particularly if a large catheter balloon is used. There is no reason to place a catheter with a balloon larger than 5 ml. Suppressive antibiotics should not be used in catheterized patients. They do not reduce the incidence of urinary tract infections, but they do create resistant organisms that are more difficult to eradicate if an acute infection does occur.

Management of Drains

Drains inserted because of the risk of hemorrhage can be safely removed after 24 hours if loss is minimal. Drains can be left for a longer period of 3 to 5 days if placed in an abscess cavity and large-bore drain without suction is more appropriate to allow drainage of viscid material and minimize trauma to surrounding tissues as a result of suction. Suction drains are useful in removing lymphatic fluids from the groins after lymphadenectomy. They may need to remain in place for 10 days. Thereafter, they are unlikely to offer any further advantage, may become infected and are better removed.

Wound Care

Sterilized dressing should be applied after vaginal surgery to protect surgical wound and sutures touching the clothes of patients and preventing seepage of blood and serum from the wound (Fig. 49.4). Wound infection should be recognized early and managed appropriately. Induration or erythema should be noted early. If infected sutures should be removed, loculations of pus should be probed and necrotic material should be removed. Appropriate antibiotic should be given.

In surgeries like vulvectomy, area should be exposed. Initially application of ice packs to the operative site to 24 to 48 hours seems to provide more comfort to the patient than heat. Later warm air blown across the perineum is both comforting and therapeutic because it helps to keep the operative site dry and stimulate blood flow enhancing healing process.

Seven to ten days after vaginoplasty, the mould has to be changed. Patient is given instructions on daily removal and reinsertion of the mould and is told how to administer low pressure douche of betadine or clear warm water. Postoperative care of vaginoplasty is shown in Figure 49.5.

Mobilization and Physiotherapy

Early mobilization reduces muscle loss through inactivity and enables the woman to return to normal activity more quickly. The rate of muscle loss associated with bedrest

Fig. 49.4: Dressing of perineum after vaginal surgery

Fig. 49.5: Mould removal and reinsertion after vaginoplasty

is dramatic. Even a reduction of 12 hours in the onset of mobilization will make a substantial difference. In addition, the risk of thromboembolic disease and respiratory infection is reduced by early mobilization.

Skilled physiotherapists are essential to facilitate early mobilization and to deal with the problems that inevitably accompany a more prolonged postoperative recovery. They play a pivotal role in the prevention and treatment of respiratory infection.

Prophylaxis for Venous Thrombosis

The most effective treatment of venous thrombosis is prevention. In view of the evidence that between 5% and 45% of patients undergoing major gynecologic surgery develop venous thrombosis of the lower extremity, a prophylactic method of preventing this complication should be considered before surgery. Low-dose subcutaneous heparin, administered at dose of 5000 units two hours preoperatively and every 12 hours post-operatively for five days, has proved efficacious in preventing thromboembolism.[12]

Postoperative Care of Elderly

It is advisable to apply elastic stockings preoperatively onto both the patient's legs from the ankle to the upper thigh. If the legs are not so wrapped, the rapid return of blood to the lower extremities may reduce the patient's blood pressure alarmingly a short time after the legs are lowered postoperatively. During surgery on the elderly and often hypertensive patient at risk, monitoring the pulmonary wedge pressure appears to be a more dependable means of interpreting blood pressure changes than is monitoring of central venous pressure.

Postoperative care of the elderly patient should emphasize pulmonary recovery through deep breathing and early ambulation. The decrease in the glomerular filtration rate is the most important renal change that occurs with advancing age. The surgeon should prescribe low dosages of those medications that are excreted primarily in the urine.

Discharge from the Hospital

The probable date of discharge from the hospital should be discussed with the patient a day or two ahead of time to give the patient and her family adequate time to make arrangements and preparations. The patient should be given very specific instructions before discharge as to what she may and may not do during her convalescence. Postoperative instructions should be clearly written or printed on the discharge paper.

Full examination of the patient is essential prior to her discharge from hospital. This includes the inspection of wounds to assess their state of healing. All unabsorbable sutures should have been removed (a nylon or silk suture in the perineum is easily overlooked), or in the event of an early discharge, a clear plan for removal of these sutures must be given to the patient. Vaginal examination is required if there is any suspicion of collection of blood or pus in the pelvis.

It is desirable for all patients to be seen 6 to 8 weeks after operation to ensure that progress is normal and that healing is complete. Instructions to the patient should include advice about return to work. After major vaginal operations, light household duties can be resumed in 3 to 4 weeks, but heavy physical effort and work outside the home should be avoided for 6 to 8 weeks. At that time, recovery is relatively complete but most women find that it takes 3 to 6 months before they feel entirely well, mentally and physically, after a major operation.

Whenever the operation has involved the vaginal walls or cervix, coitus should be refrained for 6 to 8 weeks; preferably until after the first follow-up visit. Premature attempts at coitus can cause breakdown of incisions and, if painful, may result in vaginismus with permanent dyspareunia. On the other hand, the avoidance of coitus for too long after vaginal operations may allow senile contracture to occur to such an extent as to produce permanent apareunia or dyspareunia.

Follow-up

The last duty of the surgeon is to establish and if necessary discuss the histopathological report and to communicate and arrange with specialist physician, who may be involved in subsequent care, for example radiation or medical oncologist.

CONCLUSIONS

Postoperative management is the key to success for any surgery. It includes multiple system management namely; care of wound, nutrition, care of catheter, pain management and physiotherapy. Follow-up is needed for complete rehabilitation and recovery.

Key Points

1. Aim of postoperative care should be to decrease morbidity of patient and costly hospital stay.
2. Effective postoperative analgesia using patient based methods allows early mobilization and reduces respiratory complications.
3. Antibiotic prophylaxis prevents infectious complications. Short course therapy is also equally effective and is cost effective.
4. Suprapubic bladder drainage is a better alternative where prolonged catheterization is needed.
5. Wound infections should be diagnosed early and managed appropriately.
6. Early mobilization and skilled physiotherapy is the key to prevent DVT.
7. Clear instructions should be given while discharging patient.

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Complications of Vaginal Surgery

Vijay Zutshi, Sumita Mehta

INTRODUCTION

The risk of surgical misadventure and complications can be reduced but not eliminated by careful and thorough preparation and by meticulous technique. Minimisation of the risk of mishap depends upon precision of diagnosis, appraisal of relevant medical status, selection of an appropriate therapy and achievement of safe and adequate access accompanied by knowledge of normal anatomy and its restoration.

Any surgical procedure is accompanied with its inherent complications. Every surgeon should be well-versed with the anatomy to avoid complications. It is important to diagnose complication intraoperatively, so that immediate action can be taken.

Various surgeries which can be done vaginally have been listed in Table 50.1. The complications associated with them, can occur intra-operatively or post-operatively which can be early and late. More than one complication can also occur in one patient.

The various complications seen can be general (which are same for all procedures) and specific (seen in a particular procedure only) (Tables 50.2 and 50.3).

Table 50.1: Vaginal surgeries

Minor procedures	*Major procedures*
• Cervical wedge biopsy • Conization of cervix	• Manchester repair • Vaginal hysterectomy with and without repair
• LEEP procedures	• Repair of fistula (Urinary and Rectum)
• Removal of cervical polyp	• Correction of congenital genital tract malformations
• Vaginal myomectomy	• Kustner's and Spinelli's operations for chronic inversion
• Dilatation and curettage	• Vulvectomy (Simple and Radical)
• Colpotomy	• Radical vaginal hysterectomy
• Pyometra drainage	• Laparoscopic assisted vaginal hysterectomy
• Excision of vaginal wall cyst • Marsuplization of • Bartholin cyst • Incision of hymen • Surgical repair of a perineal laceration • Episiotomy • Surgical treatment of cervical incompetence	• Hysteroscopic procedures • Radical Trachelectomy

General Complications

Risk of Anaesthesia

Rist of anaesthesia is not greater than any other surgical procedure. It is important to know that most vaginal surgeries are done under regional anaesthesia. Chances of headache due to leakage of cerebrospinal fluid is higher. This 'spinal headache' can be quite distressing for the patient. Rarely the meninges can get infected causing meningitis which may be associated with a fatal outcome.

Haemorrhage

The retropubic and pararectal spaces are not confined and do not tamponade venous bleeding. At the end of the operation, and prior to closure of the vaginal wall, the surgical field must be bleed free. Coagulation should be used with extreme caution for defined bleeders, suture

Table 50.2: General complications

1. Risk of anaesthesia
2. Haemorrhage
3. Infection
4. Injury—Bladder, Ureter, Bowel, Nerve
5. Pain
6. Urinary retention
7. Bladder instability
8. Stress incontinence
9. Fallopian tube prolapse[1] (rarely)
10. Forgotten foreign body

Table 50.3: Specific to various vaginal procedures

1. Complications due to Lithotomy position—
   Compartment syndrome
   Neurovascular complications
2. Vaginal shortening
3. Specific to each procedure

ligatures are preferred.[2] Minor vaginal oozing can be controlled by the use of vaginal packing. If bleeding is more profuse, a Foley catheter with a 50 to 60 ml balloon can be inserted against the packing. In the postoperative period, a low blood pressure, tachycardia, and a drop in the hematocrit count without external vaginal bleeding are clear signs of retropubic or retroperitoneal bleeding or intra-peritoneal bleeding. Resuscitation maneuvers are used, and re-exploration and even a laparotomy may be required. A late onset of bleeding, 5 or more days after vaginal operation, is rare. It responds usually to packing. The bleeding may result from local infection, requiring antibiotic therapy.

Infection

Initial surveys showed global infectious morbidity (temp ≥ 38°C on two measurements 6 hours apart, excluding the first 24 hours) affected 40 to 70% of patients with vaginal surgery and 30 to 40% after abdominal surgery.[3] But with use of antibiotic prophylaxis, this difference is no longer seen. Various studies have demonstrated an increased probability of postoperative infection among premenopausal as compared to postmenopausal patients. This may be due to the increased vascularity of tissues and the increased formation of hematoma which becomes a focus of infection. Greater sexual activity also increases vaginal bacterial contamination in premenopausal women.

The microorganisms causing infectious complications after vaginal surgery are aerobic gram-negative bacteria (*E. coli*, *Proteus*) and anaerobes (bacteroids, peptococci, streptococci).

Causes for Postoperative Infections

1. The anoxia and necrosis associated with surgical trauma favour the proliferation of anaerobes
2. Presence of foreign bodies such as suture material (even absorbable material increases the risk of post-operative infection.

Apparently higher frequency of infections after vaginal surgery is probably due to the fact that this type of surgery starts with direct trauma to the bacterial sanctuaries in the vagina and cervix.

It has been recommended that surgeries which do not involve opening the peritoneal cavity (cone biopsy, vaginal repair and fistula repair) do not require antibiotic prophylaxis. The personal experience of the authors is that routine antibiotic prophylaxis in cone biopsy is needed. Operations involving opening the peritoneal cavity justify antibiotic prophylaxis. Contamination of the peritoneal cavity can result in complications that can be life-threatening. Hysterectomy warrants antibiotic prophylaxis. Patients with chronic pelvic infection require antibiotics. All factors reducing resistance are indications for prophylactic antibiotics. These include patients on corticosteroids, diabetics, patients with anemia, obese and malnourished patients.

Prevention of the Infection can be done either Preoperatively or Intraoperatively

Preoperative Prevention

1. A long period of hospitalization before surgery increases the risk of postoperative infection. Also postoperative stay affects the risk of infection. A shorter length of hospital stay is associated with a significantly lower risk of wound infection in the first 10 postoperative days. It is, therefore, imperative to ensure that as far as possible hospitalization is minimized.
2. Local antiseptic treatment in the days preceding surgery actually has a negative effect. After a single application of antiseptic, the number of organisms per unit surface diminishes in the first 15 minutes. After this period the number rapidly increases so that at 60 min, the concentration is ten times the initial concentration. If one repeats the application each day

the number of organism increase whereby the risk of postoperative infection is actually increased.

3. Bowel preparation given before vaginal surgery is not generally required. But it is critical when treating a rectovaginal fistula. For other procedures generally an enema to avoid fecal soiling during the procedures is adequate.
4. Shaving increases the risk of infection. Postoperative infection can be reduced from 2.5% to 0.9% by avoiding shaving.[4]
5. The use of a vaginal pessary given immediately before surgery has an important role. It dilutes the vaginal flora without throwing it out of balance.

Intraoperative Prevention

1. Careful and complete preparation of the operative field is important. Careful placement of the drapes excluding anus from field of surgery is also important.
2. Risk of infection increases with the length of the operative procedure.
3. Rough dissection is more dangerous than careful slow dissection, which avoids devitalizing the tissues. Careful, gentle and meticulous surgical technique is the best prophylaxis against postoperative infection.
4. Drainage of the operative field continues to be a highly controversial issue in general surgery. Postoperative infectious morbidity is more common when one uses a drain, 1.5% of cases when no drain is used as compared to 2.3%-3.9% when a drain is used.[5] The main risk factor is haematoma formation. If the postoperative field is dry, the risk of hematoma is low and drainage only increases the risk of postoperative infection. When the postoperative field is hemorrhagic, a risk develops which may be reduced by drainage.

Injuries

Ureteric Injuries

Intraoperative ureteric injury during vaginal surgery occurs rarely. The incidence is less than 0.5%. Risk factors for ureteric injury include prior abdominal operation, vaginal prolapse such as enterocele or large cystocele, and multiple prior vaginal operations.[6] One can injure ureter in any of the following ways such as clamping, stitching, ligatures, incision, coagulation, and total severance.[7]

Bladder Injury

The bladder injury may be excision, incision, excessive coagulation, or clamping of the bladder wall. During surgery urine collects in the bladder, so the appearance of bloody urine that was clear at the beginning of the operation should make the surgeon suspect bladder injury. Normal saline, methylene blue or indigo carmine solutions may be instilled to locate the site of the injury.

If the injury is diagnosed at the time of operation, the bladder wall must be exposed sufficiently. A two-layer closure is required, with a running inner layer and an interrupted second layer of perivesical fascia.

Bladder injury unrecognized at the time of surgery is one of the most important complications of vaginal surgery. Prolonged haematuria, leakage of urine despite bladder drainage or severe pain in the bladder area may indicate bladder injury. A cystogram may confirm extravasation of urine and cystoscopy will confirm the location and extent of the bladder injury. Adequate bladder drainage should be obtained but some patients will develop a vesico-vaginal fistula in spite of proper drainage. After an adequate period of conservative therapy, (6 to 8 weeks) the fistula may be approached surgically.

Bowel Injury

Bowel injury at the time of vaginal surgery may occur rarely, particularly if the bowel is not prepared prior to operation. If the patient had a proper bowel preparation and the injury is easily identified, a primary repair can be performed. A multiple-layer closure should be done, and dilatation of the anal sphincter is recommended. Extensive damage of the rectum with spilling of stool matter into the surgical field requires a protective colostomy together with the repair.

Nerve Injury

Denervation of the bladder can occur after extensive vaginal surgery, which may contribute to postoperative urinary retention. Because of the proximity of the pudendal nerve to the sacrospinous ligament, injury can occur during sacrospinous fixation for vaginal vault prolapse. Peroneal nerve palsy or femoral neuropathy is rare after vaginal surgery. The patient should be carefully positioned to avoid nerve injury.

Pain

Postoperative pain is a common complication after vaginal surgery. The pain may be suprapubic, vaginal or rectal. Bladder spasms and urgency are often felt as suprapubic pain. The most distressing pain in the suprapubic area is pain related to suspension sutures. Pain is generally transitory and may require much time

before it subsides. The cause of this pain may be related to nerve entrapment, sutures tied too tight, or placement of the sutures in a mobile portion of the anterior abdominal wall (movement creates tension over the rectus muscle and fascia). Vaginal pain after surgery is rare unless hematoma or infection has occurred. Pain during intercourse may be related to vaginal stenosis or shortening of inflammation of the vaginal wall. A stitch granuloma may lead to chronic sinus infection and pain. Rectal pain may occur because of hematoma or infection in the rectovaginal space. The diagnosis is evident on physical examination; in rare cases, drainage may be necessary. Extensive perineal repair may lead to temporary peri-rectal pain.

Urinary Retention

Urinary retention after vaginal surgery is in general a temporary event. Surgical pain, medication, edema, and surgical manipulation of the bladder are all factors in postoperative inability to empty the bladder. Other factors like infection, hematoma, or suspension sutures in close proximity to the bladder neck can induce prolonged urinary retenion. Intermittent self-catheterization may be painful and difficult in the immediate postoperative period but should be initiated if urinary retention is still present 2 to 3 weeks after operation.

Bladder Instability

Symptoms of frequency, urge incontinence are generally temporary after vaginal surgery. The cause of persistent bladder instability lasting beyond 3 months after operation is not clear. Sling procedures are in particular likely to cause instability symptoms post surgery. Elderly patients are also at high-risk for bladder instability after a properly selected and well-performed bladder neck suspension. Extensive vaginal operations, particularly large cystocele repair, may cause partial bladder denervation and neurologic dysfunction.

Stress Incontinence

Stress incontinence absent prior to operation may be a complication of vaginal surgery in patients undergoing cystocele repair without concomitant bladder neck suspension. It is recommended that a procedure to elevate the bladder neck and urethra be performed in every case of cystocele and urethral hypermobility (with or without stress incontinence).[11] If this is not done, the urethra will remain hypermobile, facilitating the appearance of stress incontinence. If incontinence occurs with a well-supported urethra and bladder neck, the cause of recurrent stress incontinence is not anatomic malposition but rather intrinsic sphincter dysfunction of a normally supported urethra. Procedures like bulking injections or sling procedures are used for this condition.

Thromboembolic Complications

The rate of reported thromboembolic complications for vaginal hysterectomy vary between 0% and 3%. The risk is lower than abdominal hysterectomy. The positioning of the patient on the operating table must be watched carefully. Compression of the lower extremities by the supporting stirrups can generate stasis and a tendency to venous thrombosis. The use of ankle stirrups to avoid this problem is recommended. The use of elastic or hydraulic stockings may improve circulation, particularly in the postoperative period. The patient should be encouraged to move her legs freely while in bed and early mobilization is encouraged. Excessive analgesia and sedation may impair mobility and increase the tendency for stasis. High-risk patient with a prior history of venous thrombosis or emboli should receive anticoagulation therapy in the perioperative period. A low dose of 5000 units of subcutaneous heparin, two or three times a day, is very effective and can be easily reversed if required. If thrombosis or emboli are clinically evident, intravenous heparinization should be used.[8] (See chapter 7).

Specific Complications

Complications due to Lithotomy Position

Prolonged gynaecologic surgery, usually over 3 hours with patient in lithotomy position compromises circulation and neurologic function within the legs due to external pressure to fascial compartment by the supporting stirrups. This obstructs arteriolar circulation within the contained nerves and results in compartment syndrome and neurovascular complications.[12, 13]

Compartment syndrome: Pressure within fascial compartment is elevated leading to ischemia of muscles which promotes edema and further compresses the contained nerves.

Symptoms and Signs

1. Cramping in lower limbs (LL)
2. Muscles in LL are firm and tense although pulsations of pedal arteries are palpable.

3. Pain is accentuated upon passive stretching of muscles.
4. Symptoms rapidly progress to numbness, burning and difficulty in moving the legs. This is followed by foot drop and sensory loss over feet.

Prevention

1. Both legs and thighs should be carefully supported by padded stirrups
2. Specific attention should be paid to the position of patient's feet to avoid passive dorsi flexion of ankle.
3. Passive repositioning of the legs during the surgical procedure.

Treatment

1. Muscle pressure measurements should be obtained.[14]
2. If pressure is elevated within 12 hours of surgery, fasciotomy should be done to decompress the compartment.[14]
3. After 12 hours, risk of infection is more, so decompression is not done.
4. To aid circulation within compartment, patient's legs are positioned at the level of her heart.
5. Prognosis for recovery is good if permanent nerve and muscular damage has not occured. Recovery may take several weeks.

Neurovascular Complications

1. Peroneal nerve injury: Direct pressure from stirrups on the calf, where the peroneal nerve crosses the fibula, can occur, even with short duration of surgery. The weight of leg should be on patient's foot and not on her calf while positioning. Injury leads to foot drop; difficulty in walking and inability to abduct or evert the foot.[15] There may be numbness of lateral surface of leg and dorsal surface of foot.
2. Sciatic nerve injury: Proper positioning would require flexion of knee and hips and to ensure minimal external rotation of the hips. Patients with sciatic nerve injury develop weakness of the hamstring muscles and have difficulty in walking.
3. Femoral neuropathy: Excessive external rotation of the thighs of the patient, with legs in stirrups for longer than 1.5 hours may cause femoral neuropathy. Patient develops numbness and paresthesias of the thigh. The knee buckles when the patient stands and she cannot walk without assistance. It can be prevented by placing lateral support to each thigh and inhibiting exaggerated rotation. Treatment of all neuropathies is by physiotherapy using massage with galvanic electrical stimulation of the nerves. Recovery is often slow taking several weeks to months.

Vaginal Stenosis

Excessive excision of the vaginal wall may lead to narrowing or shortening of the vagina. During rectocele or cystocele repair, excision of vaginal tissue should be minimal. Excessive plication or tension of the suture line should be avoided. At the end of a rectocele repair, the vaginal wall should be smooth, without bumps or rings which allows the insertion of two fingers with ease.[9] A hematoma of the vaginal wall may lead to late scarring and deformity of the vaginal canal.

Enterocele and Other Prolapse

Postoperative genital prolapse may recur even after properly selected and well performed vaginal reconstructive surgery. Poor quality of the tissues, vaginal infection, or hematoma and poor general condition may increase the risk for recurrent prolapse.[10] A secondary enterocele, not present prior to operation, is a complication of any operation that alters the vaginal axis, in particular a bladder neck suspension. Suspension of the anterior vaginal wall will transfer the axis of the vagina, transferring the cul-de-sac to the most dependant part of the pelvis. Changes in intra-abdominal pressure will impact the vaginal vault and facilitate the formation of an enterocele.

COMPLICATIONS OF VARIOUS SURGICAL PROCEDURES

Minor Procedures

Dilatation and Curettage

1. Uterine perforation: It usually results from a failure to identify the axis of the uterine cavity. Myometrium that is soft because of pregnancy or invasion by malignant tumor can be perforated quite easily. When sound has perforated uterus, prompt withdrawl of instrument does not result in any morbidity. It is best to discontinue the procedure or to complete it under laparoscopic guidance.

If it has been caused by cannula or curette, it may cause serious damage to visceral contents of pelvis. Immediate laparotomy is essential if omentum, intestinal epithelium or bowel contents are obtained as curettings.

2. Asherman's syndrome: Curettage which is overdone can literally remove all the endometrium and can result in amenorrhoea. This most commonly occurs in pregnant uterus because myometrium of pregnant or aborting uterus is soft and so the curette tends to split the myometrial fibres more easily and also removes the endometrial tissue at a much greater depth.

Loop Electro-surgical Excisional Procedure (LEEP)

1. Haemorrhage: It is related to the volume of specimen removed. It occurs during the first 24 hours after surgery, generally seen after cone removal, although not as frequently as seen with cold cone. Most cases can be managed by packing alone. The incidence peaks again during postoperative day 10 after large loop excision of transformation zone (LLETZ). After 14 days the risk of hemorrhage is almost nil.[16]
2. Haematoma
3. Infection: If patient requires hysterectomy, delay of 6 weeks is recommended to avoid infection post-operatively following major surgery.
4. Cervical stenosis or cervical incompetence: It is related to volume of specimen removed and its depth.
5. Pelvic pain and abnormal bleeding due to endometritis.
6. Fertility problem: Infertility, abortion, premature delivery and uterine rupture rarely.

Electrocautery and Cryotherapy

1. Accidental burns on vagina.
2. Vaginal discharge.
   a. It is generally profuse and clear.
   b. Menstrual disturbance- After a thorough cautery, subsequent 2-3 periods may be prolonged and profuse and accompanied by a dark brown premenstrual discharge.

Cold Knife Cone Biopsy

1. Haemorrhage: Per-operative and reactionary haemorrhage are both common. Bleeding is controlled by firm vaginal packing for 24-48 hours.
2. Stenosis: If cervix is not well dilated before conization.
3. Sepsis: Especially if it is performed in the presence of infection, it produces considerable parametritis in 2-3 days.
4. Endocervical granulation-When cervix is examined after 6 months of conization, sometimes granulations are seen in the endocervical canal. They are usually symptomless and need no treatment.
5. Perforation of cervix from a too deep conization has been reported, usually into the pouch of Douglas where the small bowel may be damaged resulting in peritonitis or intestinal obstruction. Laparotomy would be needed immediately.
6. Effect on subsequent pregnancy and childbirth. Extensive conization increases the risk of abortion (13.6%), preterm labor (18%) and cervical atresia.[17]

Vaginal Myomectomy

1. Bleeding-If brisk, then 30 ml Foley's catheter can be inserted into the cervix and inflated for tamponade.
2. Cervical incompetence.

Excision of Vaginal Wall Cyst

1. Bleeding.
2. Risk of ureteral ligation when deep sutures are placed at the base of the large and high cyst cavity to control bleeding.

Trachelorraphy

Secondary haemorrhage and breakdown of the wound. This risk can be reduced by using interrupted nylon sutures which provoke minimal tissue reaction. Sutures should be cut long and left in place for 3 weeks.

Colpotomy

1. Rectal injury: If such an injury is detected during operation, it must be repaired immediately.
2. Recto-vaginal fistula and peritonitis due to undetected rectal injury may ensue.
3. Infection: It may lead to tubal, ovarian abscess and peritonitis. Preoperative antibiotics usage is evidence-based mandatory precaution.

Pyometra

1. Perforation is common and may be due to:
   a. Uterus being soft
   b. Cervical cancer growth distorting the cervical canal.[18,19]

2. Creation of false passage—Pyometra drainage associated with malignancy can cause special risk due to distorted anatomy and friable necrotic tissue. Data from our hospital was collected to analyze the difficulties encountered during pyometra drainage in sixty patients of cancer cervix between the year 2000 to 2006. Creation of false passage occured in 35.6% of patients. In these patients second attempt for drainage was done under ultrasound guidance and was successful. The conclusion from this observation was that the difficult cases of pyometra should be drained under ultrasound guidance at the first instance to avoid perforation. (Unpublished personal data Zutshi, Mehta.)
3. Peritonitis—If perforation is made and not recognized, it can lead to general peritonitis.

Episiotomy

1. Infection is relatively uncommon after episiotomy. The reported incidence is 0.1%.[20]
2. Haematoma can at times extend up to the vault.
3. Extensions of the episiotomy wound, and fistula formation are common complications. Extension resulting in third or fourth degree laceration can lead to incontinence of flatus and stool, rectovaginal fistula and infection. This is more common with midline episiotomy. Owen and Hauth reported 20% of women with midline episiotomy had a third and fourth degree laceration, compared with 9% of women with a mediolateral incision, and only 1% when no episiotomy was performed.[21]
4. Fistula is an uncommon complication of episiotomy. Cases include unrecognized lacerations in the rectovaginal septum at the time of episiotomy repair or infected hematoma. Risk factors for fistula formation include obesity, poor hygiene, malnutrition, anaemia, connective tissue disease, history of inflammatory disease. Half of these fistulas heal spontaneously, but repair should be considered if the patient is symptomatic.

Cerclage Operation

1. Haemorrhage and haematoma formation.
2. Rupture of membranes
3. Chorioamnionitis.
4. Acute retention of urine

Major Procedures

Manchester Repair

1. Bleeding
2. Hematoma
3. Enterocele—If the cardinal-uterosacral ligament complex is of poor quality, it may be inadequate to support the vaginal vault postoperatively. If there is no significant elongation of the cervix, amputation of a normal sized cervix as a means of mobilizing the cardinal–uterosacral ligament may disrupt the integrity of the internal cervical os, causing risk of cervical incompetence.
4. Cervical stenosis may lead to mechanical dysmenorrhoea and secondary infertility.
5. Labor dystocia-following colporrhaphy diminished size or calibre of vagina will interfere in subsequent labor and delivery.

Vaginal Hysterectomy without Repair

Intraoperative Complications

1. Haemorrhage
   a. Excessive intraoperative bleeding due to wrong planes or if there is increased vascularity in the patient.
   b. Section of the uterine artery or slippage of ligature can cause significant bleeding. Management is not easy but should be carried out immediately. If the accident happens after exteriorization, retractors are used to reveal the bleeding vessel which is clamped and then doubly ligated.
   c. Tearing of slipping of ovarian ligament gives rise to bleeding which is generally minimal but must be controlled. If the bleeder is deeper and one does not succeed in controlling the haemorrhage, laparoscopy or laparotomy has to be done.
   d. Slipping of ligature around the round ligament pedicle leads to bleeding which is generally moderate. This is managed by suturing after extraction of the uterus.
2. Visceral injuries
   a. Bladder injuries: These are more frequent during vaginal hysterectomy than abdominal hysterectomy. The injuries are rarely a neat cut, rather they are ragged and bruised. It occurs after the surgeon has created a false passage in the bladder wall,

which then enters the bladder lumen. The bladder is generally empty at the time of injury, and so the injury is not always detected immediately.

b. Intestinal injuries: Injury to rectum is rare. These are repaired immediately with interrupted extramucosal sutures aligned transversely.

3. Inability to extract the uterus: When the indication is appropriately selected vaginal hysterectomy is always possible. But if one has to abandon the vaginal route, don't wait too long. Patient must be made aware of the fact that one may have to resort to abdominal route.

Postoperative Complications

1. Thomboembolism
2. Pulmonary complications
3. Infection
4. Ileus
5. Bleeding: Primary haemorrhage and first 24 hours haemorrhage requiring intervention is observed in 1% of cases.[22] It occurs more frequently in patient who is pre-menopausal or with history of abnormal uterine bleeding. If moderate haemorrhage occurs without evidence of collapse or fall in hemoglobin vaginal packing is done after speculum examination. If haemorrhage is heavy or if it persists, patient is taken to operation theatre and is evaluated under general anesthesia with proper position and light. Bladder is catheterized, vaginal stitches are cut and all the clots are evacuated. Whatever the situation may be, all the stumps must be prophylactically resutured. Haemorrhage after first postoperative day is rare. Secondary haemorrhage is due to exaggeration of healing process and formation of granulation tissue.An early resumption of sexual intercourse may also cause bleeding. Management is by packing and antibiotics.
2. Infectious complications: An isolated rise in temperature is relatively frequent in 5-15% cases and does not necessarily indicate infection. Urinary tract infection is more frequent in patient operated transvaginally, rather than abdominally. Usual symptoms of cystitis may be absent. Many patients are totally asymptomatic. If symptomatic, antibiotic therapy is necessary in order to prevent infection, catheterization and draining of the bladder is avoided. Vault abscess can develop if infection develops in the cellular pelvic tissue in contact with vaginal vault. It is associated with moderate fever of 38-38.5°C, turbid offensive vaginal discharge and on per vaginal examination pelvic cellular tissue is felt thickened and edematous. It is treated with antibiotics. Pelvic abscess includes fallopian tube abscess and abscess in pouch of Douglas presenting on fourth postoperative day. First symptom is fever, accompanied by signs of a pelvic collection developing laterally or posteriorly. Ultrasonography and/or examination in operation theatre confirms the diagnosis and allows guided puncture, lavage and drainage. These infections can lead to peritonitis which might respond to antibiotics initially. But if there is medium or late term pelvic suppuration, relaparotomy may be necessary.
3. Fistulae

   VVF: It is formed in 2/1,000 cases.[23] If diagnosis is made immediately, it can heal with drainage alone. If urinary discharge persists after 20 days, chances of spontaneous cure is rare and re-operation after 3 months is required. To prevent these fistulae, bladder dissection must be performed atraumatically in the extra-facial plane.

   RVF: One can try colostomy for spontaneous healing. Otherwise surgical treatment is advocated once edges of fistula are well defined. After complete healing colostomy is closed.

   Uretero-vaginal fistula: Careful dissection is needed in cases where cone biopsy/amputation of cervix have modified the anatomical relationships between ureter and the uterine artery. Applying pressure with finger, on the inside of the arch of the uterine artery before passing the needle, reflects the ureter away and prevents damage to it.

Vaginal Hysterectomy with Anterior Colporrhaphy and Colpo-perineorrhaphy

In addition to the complications of vaginal hysterectomy, other complications seen are:

1. Injuries to the bladder and intestine. Injury to the ureter paradoxically is not as common. Although, the knee of ureter is lower during transvaginal surgery for pelvic relaxation, but the arch of the uterine isthmus curves down even further thus reducing the risk of injury during division of the arteries.
2. Urinary problems

   Stress incontinence (SI): It can be anticipated before surgery by eliciting SI (which is done by taking a good history, careful clinical examination and uro-

dynamics). Where it is detected, specific procedures must be added to standard ventral colporrhaphy. Routine prophylactic incontinence surgery is associated with longer hospitalizations but does not add to the immediate morbidity of the surgery.Urinary retention can occur after removal of urinary catheter and depends on the details of operative technique. Micturition may be incomplete (residual>50 ml) or complete retention (overflow incontinence). There is no correlation between anatomy and the functional syndrome of urinary urgency. It can occur whatever the initial lesion and whatever the extent of surgical correlation. There is no predictive tool for it. It is treated by biofeedback and drugs.

3. Dyspareunia: It is due to shortening of the vaginal cavity due to excessive removal of vaginal skin. Alteration of the lower third of vagina causes superficial dyspareunia, middle third can cause complete dyspareunia, while alteration of upper third is less likely to produce any consequence.
4. Failures: After triple operation, failure of bladder support or recurrent enterocele can be early (due to strategic or technical mistakes) and late (due to aging of the patient and perineal supports).

Vaginal vault prolapse and recurrent cystocele/rectocele is due to missed enterocele or atrophic lengthening of the paracervical ligaments causing inversion of vaginal vault into vaginal cavity. Lengthening of paracervical ligaments should be evaluated intraoperatively by pulling on the stumps of these ligaments; if they do not descend up to the introitus then McCall stitch is adequate. True recurrent cystocele/rectocele occurs after a correctly executed ventral/dorsal colporrhaphy. Weakening of the repaired fascia is the main cause. An incomplete management of a paravaginal defect can also lead to its formation.

Radical Vaginal Hysterectomy

Early Complications

1. Bladder injury: It occurs when bladder cleavage is not properly identified. To avoid such complications methylene blue dye can be instilled in bladder before surgery to permit immediate identification and repair of any such injury.
2. Bleeding: It occurs during dissection of paravesical spaces if the space has been penetrated by the operator too far laterally (thus interrupting vessels affluent to hypogastric artery) and too far medially (injuring the uterine vessels) or if penetration is too low (lacerating the cardinal ligament). Exerting pressure with a gauze controls hemorrhage.
3. Injury to ureter: Difficulties arise in dissection of ureter in the canal if there is presence of residual levator fibres adhering to the pillar or an incomplete mobilization of the bladder.
4. Bowel injury: To prevent this, moderate Trendelenburg position and introduction of a broad and lengthy gauze tape into peritoneal cavity is desired to maintain bowel above sacrum. Rectal pillars are separated from peritoneum and the rectum, and they are subsequently resected close to rectal walls.

Late Complications

1. Vesicourethral dysfunction is less common (62.5%) than after radical abdominal procedures (80.5%). The symptoms include dysuria, urinary incontinence and loss of proprioceptive sensation.[24]
2. Vesical fistula occurs rarely after vaginal procedures (0 to 0.7% compared to 2.3% to 2.8% with the Werthiem's procedure).[25]
3. Bowel fistula occurs rarely, approximately 0.6%.[26]

Vaginoplasty

McIndoe-Jayes Operation

1. Injury to rectum occurs during dissection in the space between the bladder and urethra in front and the rectum posteriorly. A finger in the rectum is a great help during this dissection.
2. Haemorrhage is rare but it is essential to achieve complete hemostasis because ooze is generalised.
3. Fistula: Both rectovaginal and urethro-vaginal can occur due to pressure necrosis of anterior vaginal wall and anterior rectal wall by the mould.

William's Vaginoplasty

1. Micturition problems mainly anatomically but functionally is quite satisfactory.
2. Difficulty in coitus due to alteration in vaginal axis.

Vaginal Septae Excision

Bladder/rectal injury during excision of the septum.

Vaginal Vault Prolapse

McCall Culdoplasty

1. Laceration of bowel or rectum.
2. Ureteral injury and ureterovaginal fistula.
3. Vault hematoma

Sacrospinous Ligament Fixation

1. Hemorrhage: Injury can occur to hypogastric venous plexus, inferior gluteal vessels and internal pudendal vessels. Injury can occur from over zealous dissection or inappropriate needle passage through sacrospinous ligament.
2. Rectal injury: It may be due to constant retraction, which is required with two to three retractors.
3. Pudendal nerve injury: Patient will complain of servere postoperative gluteal pain extending down posterior surface of affected ligament. Sutures if placed too close to ischial spine can injure pudendal and sciatic nerve. 10%-15% have transverse pain on side of sacrospinous suspension, which resolves by 6 weeks.
4. Stress urinary incontinence: It is due to straightening of posterior urethro-vesical junction. Preoperative stress test in standing position with reduction of prolapse should be done to avoid this.

High Ureterosacral Ligament Suspension with Fascial Reconstruction

1. Uretral injury or kinking is the most common complication with risks quoted as 2.4%, 11% and 1% in various studies.[27] It is important to do intraoperative cystoscopy to ensure uretral patency.
2. Bowel and bladder injury.

LeFort Partial Colpocleisis

1. Haematoma
2. Recurrence rate of 2-5%.

Surgery for Urinary Incontinence

Urinary Stress Incontinence

Marshall-Marchette-Krantz (MMK) operation:

1. Postoperative voiding difficulty occurs as urethra is elevated into a fixed position behind the pubic symphysis which kinks the urethra into an unnatural position.
2. Osteitis pubis can occur if sutures are placed directly into the periosteum.
3. Chronic irritative voiding symptoms is due to placement of sutures too near or even into the urethra.
4. Enterocele formation occurs due to urethral elevation which pulls the vagina forward and predisposes to enterocele.

Tension-free vaginal tape (TVT)

1. Retropubic bleeding and hematoma which may require surgical drainage.
2. Voiding difficulty if sling is too tight. It may require transection of tape completely.[28]
3. Mesh erosion.
4. Rarely, laceration of great iliac vessels along pelvic side wall.

Transobturator tape (TOT)

Same as TVT but the complications are practically nil.

Inverted Burch Operation

1. Injury to the genital branches of genitofemoral nerve
2. Bladder injury
3. Bleeding in space of Retzius.

Vesico-Vaginal Fistula (VVF)

Stress incontinence can occur after successful repair of obstetric VVF in 10%-12% of cases.Waaldiju subjectively documented stress incontinence in 1% when there was no sphincter involvement in the fistula, 13% where there was sphincter involvement but no tissue loss and 16% when both sphincter and tissue loss present.[29]

Surgery for Chronic Inversion

Transvaginal surgery for chronic inversion is the Kustner operation and Spinelli operation.

1. Rectal injury can occur during colpotomy in Kustner's operation.
2. Pelvic adhesion formation-There is greater risk of pelvic adhesions to the recently sutured posterior uterine wall (Kustner's operation) than to anterior wall (Spinelli operation).
3. Uterine rupture in future pregnancy. As the posterior uterine incision is not availabe for palpation during subsequent pregnancy, risk of silent rupture increases.

VULVA

Bartholin Cystectomy

1. Large cyst may develop posteriorly and approximate the rectum hence, chances of rectal injury are there. Rectal wall can be distinguished from the cyst by inserting a finger into the rectum during dissection.
2. Persistent bleeding from labia or vestibular bulb can cause a postoperative hematoma of the labia, which can progress to include the mons pubis and abdominal wall beneath the scarpa fascia.

Marsupialization

1. Recurrence of cyst is seen in 10% to 15% cases due to closure and secondary fibrosis of the orifice after marsupialization.[30]
2. Abscess formation though rare.

Simple Vulvectomy

Early Complications

Bleeding is mainly at clitoris especially from dorsal vein of clitoris and from pudendal vessels, which enter at lower one-third of vulva close to opening of Bartholin duct.

Late Complications

1. Constriction of vaginal introitus and dyspareunia
2. Local cellulitis

Radical Vulvectomy

Early Complications

1. Wound breakdown can occur due to extensive undermining of skin, fluid collection in wound and infection.Considerable tension on the sutures during wound closure is a major contributing factor to wound breakdown. The single most effective method of reducing groin wound breakdown is the use of separate incisions.[31,32]
2. Seroma/lymphocyst in groin: It is seen in 10 to 20% patients. When fluid collection is small and asymptomatic it is left alone or repeated aspirations may be done until resolution occurs. When there is infection, prompt hospitalization with drainage and intravenous antibiotics is necessary.
3. Femoral nerve injury: Commonly a few sensory branches are sacrificed resulting in numbness or paraesthesias of anterior thigh, but injury of a major portion of nerve lateral to cut results in significant and permanent difficulty in walking. It can be prevented by avoiding dissection on lateral side of femoral artery.
4. Urinary tract infection
5. Severe postoperative haemorrhage from femoral vessel rupture. It can be due to wound breakdown with associated infection and necrosis involving the exposed and denuded femoral vessels walls. With use of separate incisions and avoidence of vessel skeletonization, postoperative femoral vessel rupture is now rare.
6. Thromboembolism: Most of the patients are elderly with coexisting medical problems, malignancy and femoral vein trauma and therefore risk of thrombo-embolism is high which needs thomboprophylaxis.
7. Osteitis pubis and osteomyelitis may not become symptomatic until several weeks. Extensive use of cautery on periosteum should be avoided. Mainstay of treatment is bed rest and NSAIDs. Rarely, frank osteomyelitis of pubic bone develops.

Late Complications

1. Lower limb edema persists chronically in about 10% of patients. Various factors implicated are pelvic lymphadenectomy, groin radiotherapy, major groin wound breakdown, and postoperative lower extremity lymphangitis. Patient should wear fitted support stockings for first 6 months to 1 year after surgery. Low dose prophylactic antibiotics are given to prevent lower limb lymphangitis. Management includes intermittent leg elevation, manual lymphatic drainage, carefully tailored moderate exercise program, fitted compression stockings and pneumatic compression.[33]
2. Sexual dysfunction and dyspareunia due to stenosis or scar tissue is a common problem. Patients experience marked sense of disfigurement and reduction in genital sensitivity. Increasing evidence suggests that a modified radical vulvectomy with preservation of anterior vulvar structures helps to maintain sexual function.
3. Cystocele/rectocele due to resection of perineal body with the attendant loss of its support.

4. Due to poor alignment of the urethra, a hood of periclitoral tissue obstructing path of urinary stream or asymmetry created by a hemivulvectomy causes spraying or misdirection of the urinary stream.
5. Femoral or inguinal hernia is avoided by not giving incision on the inguinal ligament. If any apparent weakness of the femoral or inguinal canal is noted at time of surgery, it should be repaired at that time.

ENDOSCOPIC SURGERIES

Laparoscopic Assisted Vaginal Hysterectomy (LAVH)

The complications of vaginal hysterectomy stay the same; in addition the complications of laparoscopy are added.[34]

1. Emphysema occurs due to extraperitoneal insufflation by incorrect placement of the Veress needle. When it is recognized, CO_2, should be allowed to escape and the needle reinserted. The emphysema will resolve spontaneously. If it extends to mediastinum, mediastinal emphysema can occur. As much gas should be allowed to escape and the patient carefully monitored. Severe cases may require assisted ventilation. Emphysema of the omentum is usually a self-limited problem but may make visualization of the abdominopelvic structures more difficult. Rarely, a penetrating injury to a blood vessel may lead to gas embolism. The anesthetist can recognize the classic 'mill-wheel' murmur associated with it over the precordium. The patient in these cases should be hyperventilated with 100% oxygen and given cardiovascular support.
2. The Veress needle or trocar may traumatize omental or mesenteric blood vessels or any of the major abdominal or pelvic arteries or veins. Thin patients are at particular risk of vessel injury. Elevating the anterior abdominal wall and directing the needle or trocar towards the pelvic area may avoid most of these serious complications. Injury to small vessels, such as omental vessels, may require coagulation. Major vessel injury usually requires immediate laparotomy, transfusion, and vascular repair. Both pairs of epigastric vessels can be injured during placement of accessory trocars. The superficial epigastric vessels can usually be identified by transillumination and injury is avoided. The inferior epigastric vessels are deeper, making transillumination difficult. So, direct laparoscopic visualization of the inferior epigastric vessels and insertion of trocars lateral to the edge of the rectus muscle (6 to 7 cm lateral to the midline) will decrease the risk of vessel laceration. Bleeding from superficial vessels can often be controlled by pressure. The trocar sleeve may tamponade bleeding if left in place during the procedure. If the trocar sleeve does not completely stop the bleeding, an additional port can be placed, and instruments can be used to achieve hemostasis intracorporally. The bipolar forceps can be used to coagulate the vessel. Alternatively, sutures can be placed through the anterior abdominal wall.
3. Gastric injury is uncommon, but the risk is increased by gastric distension after intubation. If the intubation is difficult, it may be wise to have a nasogastric tube placed to decompress the stomach before placement of the veress needle. Injury to the intestines can occur during insertion of the veress needle or trocars, or at the time of operative laparoscopic procedures. Injuries are more common in patients who have had previous abdominal surgery or pelvic adhesive disease. Once the laparoscope is inserted, the site of penetration is carefully examined. Most needle injuries do not require laparotomy but should be closely monitored. A hemostatic injury to the bowel serosa need not be repaired If the laparoscope enters the lumen, it should be left in place to limit peritoneal soiling and facilitate identification of the injured site and a laparotomy should be performed. Thermal injury can be caused by direct contact of electrical, thermal, or laser energy with an organ or tissue. With electrical injury, the full extent of damage may not become obvious immediately, and patients may be asymptomatic for up to 3 days. Abdominal pain and signs of peritonitis in a patient who has recently undergone operative laparoscopy should raise the suspicion of a thermal bowel injury. Significant thermal bowel injury should be treated with wide resection and/or reanastomosis.
4. The bladder can be injured as the trocar is inserted. This is more common in patients who have had previous pelvic surgery. If the procedure is expected to take longer than 30 minutes, a catheter should be inserted for continuous bladder drainage. The size of the bladder injury will decide the treatment. Veress needle perforations can be managed expectantly. Lacerations smaller than 5 mm may heal spontaneously if the bladder is drained continuously for 4 to 5 days postoperatively. Larger injuries require suturing.

5. Ureter is particularly susceptible to injury when adhesions or endometriosis involves the pelvic sidewall. Illuminated ureteral stents can sometimes be helpful in locating the ureters if the anatomy is severely distorted.
6. Although rare, bowel can herniate through laparoscopic incisions and become incarcerated. The Z-track method can lessen the risk of herniation. Ports larger than 7 mm mandate closure of the fascia with sutures to avoid this.

Hysteroscopy

Overall complication rate ranges from 12-43%.

Intraoperative Complications

1. Fluid overload results in acute hyponatremiă, which further causes cerebral edema. To avoid this complication, preoperative, intraoperative and four hours postoperative serum sodium level should be determined.
2. Bleeding can be managed by aspirating the blood and by increasing the pressure of the distending medium so that it exceeds the arterial pressure and compresses the walls of the uterus sufficiently to stop bleeding.
3. Uterine perforation occurs most commonly during septum resection, myomectomy and adhesiolysis. To avoid this, simultaneous laparoscopy is advocated. The most dangerous perforations are those associated with lasers and electrosurgical devices. If a perforation occurs with these devices, then laparotomy is required to ensure that no injury has been inflicted on the adjoining viscera. The operator can suspect perforation when distension becomes difficult to maintain and the flow of distending medium exits from the perforation site.

Postoperative Complications

1. Bleeding: It is most commonly associated with endometrial slough (after ablation), chronic endometritis, or spontaneous extrusion of the intramyometrial portion of a previously resected submucous myoma.
2. Infection: Infection is an unlikely complication associated with hysteroscopy. Baggish et al observed infections in only 13 cases amongst 5000 cases of hysteroscopy.[35]
3. Perforation of uterus during hysteroscopy can place woman at an increased risk for uterine rupture during her future pregnancy.[36] Also, pregnancy loss (75%) and adherent placenta are more common.[37]

CONCLUSIONS

The correct management of postoperative complications is a matter of fine judgement. Careful preoperative evaluation and awareness of the devastating complications associated with the particular surgical procedure will allow their prevention, early diagnosis and appropriate therapy. Every surgeon must recognise the obligation to acknowledge personal weaknesses and to review them from time to time so as to continually improve and develop the skills to prevent less than satisfactory results.

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State-of-the-Art Vaginal Surgery

State-of-the-Art Vaginal Surgery offers complete and detailed coverage of the various techniques and skills of vaginal surgery.

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Did her graduation and postgraduation from LHMC, Delhi. She has been a meritorious student. At present she is working as Professor at UCMS and GTB Hospital, Delhi. She is a very popular and capable teacher. Her surgical skills are par excellence. She is a keen researcher and has a large number of credible National and International publications. She has special interest in menopausal medicine and reproductive endocrinology and has authored 3 books the last being 'Advances in Obstetrics and Gynecology' which was well appreciated. She has mastered the technique of non-descent vaginal hysterectomy specially removal of large uteri. *State-of-the-Art Vaginal Surgery* has also originated from her passion for vaginal surgery.

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Her exceptional skills as a writer, speaker, and editor have been showcased in all major conferences, CME programs, journal articles and chapters. Her peers hold her in high esteem for her academic and professional expertise. Her interest in surgical oncology and interaction with oncosurgeons has provided *State-of-the-Art Vaginal Surgery* with valuable chapters on oncology.

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